ePact
Strengthening evaluation effectiveness and impact

UKaid
from the British people

External evaluation of mobile phone technology-based nutrition and agriculture advisory services in Africa

Mobile phones, nutrition, and health in Tanzania: Business modelling endline report

Nigel Scott, Simon Batchelor, and Tom Jones (Gamos)

Final version for publication 27/3/2020

Oxford Policy Management · itad · IDS Institute of Development Studies · Gamos · IFPRI International Food Policy Research Institute

e-Pact is a consortium led by Oxford Policy Management and co-managed with Itad

Acknowledgements

The authors would like to thank all of the stakeholders who agreed to take part in this research and to be interviewed. We are grateful to the GSM Association (GSMA), Cardno, the mHealth Tanzania Public–Private Partnership (mHealth Tanzania-PPP), the Tanzania Food and Nutrition Centre (TFNC), the Tanzanian Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC), and the Global Alliance for Improved Nutrition (GAIN) teams for their ongoing cooperation, and to the UK Foreign, Commonwealth and Development Office (FCDO) and Oxford Policy Management (OPM) for their continued support and contributions to this project. We would also thank all stakeholders who were interviewed (often several times) for their time and patience. Finally, we would like to thank all internal and external reviewers of draft reports.

We are also extremely grateful for the ongoing collaborative partnership with the Institute of Development Studies (IDS), which is overseeing the evaluation's qualitative component, led by Inka Barnett, and the International Food Policy Research Institute (IFPRI) team overseeing the quantitative randomised control trial component, led by Daniel O. Gilligan. Both teams have provided invaluable feedback and support towards the design and tools, as well as comments on drafts of this report.

This project is being led by the Institute of Development Studies (IDS) together with Gamos and the International Food Policy Research Institute (IFPRI), as part of the e-Pact consortium led by Oxford Policy Management (OPM) co-managed with Itad. The IDS project manager is Jessica Gordon [j.gordon@ids.ac.uk]. The report authors are Nigel Scott, Simon Batchelor and Tom Jones. For further information contact j.gordon@ids.ac.uk.

The contact point for the client is Luisa Odell [Luisa.Odell@fcdo.gov.uk]. The client reference number for the project is PO6420.

e-Pact
Level 3, Clarendon House
52 Cornmarket Street
Oxford OX1 3HJ
United Kingdom
Tel +44 (0) 1865 207300
Fax +44 (0) 1865 207301
Email admin@opml.co.uk
Website www.opml.co.uk

Disclaimer

This report has been prepared by the e-Pact consortium for the named client, for services specified in the Terms of Reference and contract of engagement. The information contained in this report shall not be disclosed to any other party, or used or disclosed in whole or in part without agreement from the e-Pact consortium. For reports that are formally put into the public domain, any use of the information in this report should include a citation that acknowledges the e-Pact consortium as the author of the report.

This confidentiality clause applies to all pages and information included in this report.

This material has been funded by UK aid from the UK government; however, the views expressed do not necessarily reflect the UK government's official policies.

This project is being led by the Institute of Development Studies (IDS) together with Gamos and the International Food Policy Research Institute (IFPRI), as part of the e-Pact consortium led by Oxford Policy Management (OPM) co-managed with Itad. The IDS project manager is Jessica Gordon [j.gordon@ids.ac.uk]. The report authors are Nigel Scott, Simon Batchelor and Tom Jones. For further information contact j.gordon@ids.ac.uk.

The contact point for the client is Luisa Odell [Luisa.Odell@fcdo.gov.uk]. The client reference number for the project is PO6420.

e-Pact
Level 3, Clarendon House
52 Cornmarket Street
Oxford OX1 3HJ
United Kingdom
Tel +44 (0) 1865 207300
Fax +44 (0) 1865 207301
Email admin@opml.co.uk
Website www.opml.co.uk

Data management

All intellectual property rights in any materials produced from the evaluation (including publication of research findings and any other reports and data) remain the property of IDS and associated subcontracted collaborators. IDS and all subcontracted partners undertaking data collection have specific arrangements in place for handling data generated from the project in accordance with the Data Protection Act (1998), which includes the processing and storage of any sensitive personal data and maintenance of privacy. FCDO has unlimited access to any material produced from the evaluation. In order to promote the use and uptake of the evaluation findings, and in line with FCDO's Enhance and Open Access Policy, the evaluation team is committed to ensuring all major report outputs and associated data generated from this project are made publicly available in an accessible format. Following approval of the report by FCDO, the endline report will be made available on IFPRI's and IDS's websites.

This project is being led by the Institute of Development Studies (IDS) together with Gamos and the International Food Policy Research Institute (IFPRI), as part of the e-Pact consortium led by Oxford Policy Management (OPM) co-managed with Itad. The IDS project manager is Jessica Gordon [j.gordon@ids.ac.uk]. The report authors are Nigel Scott, Simon Batchelor and Tom Jones. For further information contact j.gordon@ids.ac.uk.

The contact point for the client is Luisa Odell [Luisa.Odell@fcdo.gov.uk]. The client reference number for the project is PO6420.

e-Pact	Level 3, Clarendon House	Tel	+44 (0) 1865 207300
	52 Cornmarket Street	Fax	+44 (0) 1865 207301
	Oxford OX1 3HJ	Email	admin@opml.co.uk
	United Kingdom	Website	www.opml.co.uk

Executive summary

mNutrition in Tanzania

The mNutrition initiative is a five-year global programme supported by the UK Foreign, Commonwealth and Development Office (FCDO), managed and supported by the GSM Association (GSMA), and implemented by in-country mobile network operators (MNOs) and third-party providers that seeks to use mobile technology to improve the health and nutritional status of children and adults in low-income countries around the world. The mNutrition initiative is implemented through existing mAgri and mHealth programmes in 12 countries throughout sub-Saharan Africa and South Asia. FCDO committed to conducting an independent evaluation of the mNutrition initiative. Given the scale of the mNutrition service the decision was made to select two countries for inclusion in the evaluation: the mHealth service in Tanzania and the mAgri service in Ghana. The mNutrition intervention that is the focus of the evaluation in Tanzania, and of this report, is an integrated service that combined an existing SMS-based health communication campaign that targeted pregnant women and mothers of young children, known as 'Healthy Pregnancy, Healthy Baby' (HPHB), with approximately 120 nutrition-focused SMS messages in Swahili. The combined service is called Wazazi Nipendeni and is managed by Cardno and delivered through a platform implemented by Rasello. The combined service sendsout SMS messages timed to the stage of pregnancy or age of child. The service is designed to provide relevant information for pregnant women and children up to the age of five in order to affect beliefs and behaviours in key nutrition-related areas, including infant and young child feeding (IYCF) and women's dietary diversity, in recipient households.

Evaluation design

The aim of the impact evaluation is to assess the impact, cost-effectiveness, and commercial viability of the mNutrition service. The evaluation is being conducted by a consortium of researchers from Gamos, the Institute of Development Studies (IDS), and the International Food Policy Research Institute (IFPRI), and it relies on a variety of different tools and methods to collect evidence on the impact of the mNutrition intervention in Tanzania. Broadly, the evaluation can be classified into three distinct but closely integrated components: a qualitative component, a quantitative component, and a business model and cost-effectiveness component.

Given the complexity of the partnerships involved in the mNutrition projects, Osterwalder and Pigneur's (2010) inductive approach to business model generation is used as a framework for the research (summarised in Annex C)[1]. The aim of this endline report is to provide a detailed description of each of the building blocks of the business model canvas, based on insights gained throughout the duration of the study.

This business modelling report draws on the quantitative component, which employed a cluster randomised controlled trial to identify the causal effect of the service on nutrition knowledge, IYCF practices, women's dietary diversity, and the nutritional status of young children. Surveyed households in villages randomly assigned to the treatment group were offered access to the mNutrition content on a mobile phone, free of charge, through a door-to-door, in-person visit; households in villages randomly assigned to the control group did not receive any offer of access

[1] The framework is used to describe a business model in the nine building blocks of the business model canvas. At the centre of the canvas is the Value proposition; half of the remaining blocks are customer facing (e.g. customer segments and channels), and the other half focus on the internal workings of the organisation (e.g. activities and partners).

to the service. Baseline and endline surveys were conducted at a two-year interval. Details of the methodology can be found in Gilligan *et al.*, (2019).

The history of Wazazi Nipendeni

The original GSMA (and FCDO) vision for the mNutrition programme was to create something different to the many existing pilots, which up to that point focused on utilising mobiles and smart devices to strengthen health systems. The intention of the mNutrition programme was to offer a consumer-facing product at scale. The original vision was for a convening space, or clearing house, which any party interested in providing health-related services could subscribe to. This 'one-stop shop' would lower the barriers of entry to mHealth services: with infrastructure and agreements with MNOs already in place, any institution wishing to set up an mHealth information dissemination service (or other related value added services (VAS)) could do so at relatively low cost. This concept was ambitiousand centred around getting potentially competing organisations to collaborate. Eventually, timescales conspired against that concept, and GSMA entered into more conventional partnerships with mobile operators. They identified in Tanzania an mHealth Tanzania Public–Private Partnership (mHealth Tanzania-PPP) which was supporting a consumer- facing product for pregnant women called Wazazi Nipendeni. The product was something of an exception to the original intention as it was hosted by a public–private partnership (PPP) that, although it had agreements with four mobile operators, was independent of any single MNO.

The Wazazi Nipendeni service (and the mHealth Tanzania-PPP) can trace its roots back to one of the earliest information and communication technologies (ICT) for development pilot projects (Voxiva), funded by InfoDev. The Voxiva system was deployed in 2001 in Peru, and enabled real-time data collection, data analysis, and dissemination of response information using public payphones. When the President's Emergency Plan for AIDS Relief (PEPFAR) programme was launched in 2003, it partnered with Voxiva as part of a consortium in Rwanda. PEPFAR was keen on working with PPPs, and it set up seven multi-country PPPs in 2007, one of which was 'Phones for Health', in which Voxiva and GSMA were partners (amongst others). In 2010, the Phones for Health programme set up a local PPP in Tanzania and in 2011 the name was changed to the mHealth Tanzania-PPP. Then Cardno was contracted to manage the mHealth Tanzania-PPP under a five-year agreement covering the period 2015–2020. Most recently, the appointment of a health specialist as the team leader signals a shift in the focus of the PPP away from technology and towards public health.

The Wazazi Nipendeni service

Insights into the Wazazi Nipendeni service are described using the structure of the Osterwalder and Pigneur canvas.

Customer segments. The vast majority of active users (78%) were women who had given birth. Although men are recognised as a key customer segment, supporters (which includes husbands) make up only a small proportion of Wazazi Nipendeni users.

Value proposition. Evidence from the quantitative study confirms the quality of messages. Between 82.7% and 91.6% of households read all the mNutrition content they received and over 90% of users either always or very often found the messages useful, indicating that the messages are highly valued. Over 90% of users (93.5% of females and 92.2% of males) would recommend the service. 89% of females and 81% of males self-reported implementing at least one tip and the

quantitative study confirmed that that access to the service did lead to changes in some nutrition-related behaviours.

Channels. In the 2015 Tanzania DHS survey, 53% respondents had heard of Wazazi Nipendeni, mostly through the radio. The single largest reason for not receiving messages was that users had lost their SIM. Registration data show that up to 83% of users were registered by partners. This highlights the importance of partners in getting users onto the system.

Customer relationships. Customer relationships are important for acquisition, retention, and compliance. Registration data confirm the importance of field partners and the face-to-face interaction they provide in encouraging users to register for the service. Opt-out rates were lower among users who had been registered by partners. High levels of satisfaction and perceived quality support high retention levels.

Revenue streams and indirect benefits. Average revenue per user (ARPU) was higher among users. Control households spent an average of TZS 5,300 per month (£1.90/month) on mobile phone airtime (including any data bundles), but spending was 10% higher (TZS 510, £0.18/month) in treatment communities. The qualitative study found this was due to women becoming more confident in using their phones. There is no evidence that Wazazi Nipendeni had reduced churn.

Key resources. The content database was brought by the mHealth Tanzania-PPP, with additional content generated through the mNutrition programme. This nutrition content is regarded as a public good, having been paid for by FCDO. In March 2019, CABI made this content publicly available under open access through their Knowledge Bank resource. The new technology platform offers improved reliability as well as improved monitoring and reporting facilities. The key ‘resource’ in convening partnerships has been, and will continue to be, the partnership with the Tanzania Food and Nutrition Centre (TFNC) and its linkages to both national nutrition policymakers and health and nutrition interventions launching in the country.

Key activities. Both TFNC and the mHealth Tanzania-PPP have good networking contacts with which to broker partnerships with field non-governmental organisations (NGOs) and MNOs. This face-to-face field presence is important, given that messages play an important role in reinforcing and supporting the efforts of health workers. TFNC also played an important role in localising content.

Key partnerships. Wazazi Nipendeni is unique in the complexity of the underlying partnerships. Partnerships have been crucial to accessing all the resources needed to make the service succeed: Research and design, Content development, Technology platform, Telecoms operators, Field partners, Government agencies. During the study, the mHealth Tanzania-PPP has successfully revised agreements with MNOs, negotiated partnerships with new health agencies, and migrated the system to a local platform provider,

Costs and investment. Since the baseline study, a more detailed breakdown of costs has been provided by partners and has been used as the basis for the financial analysis. The per country mNutrition budget was just over £1 million (for mHealth projects) but the investment needed to replicate the content was estimated at £312,500 (localising content, user experience (UX) research and monitoring and evaluation). Fixed costs were dominant, notably administration (staff) and the cost of the platform, even when SMS messages were costed at retail prices.

User numbers. The report includes an analysis of registration data provided by Rasello, which contained known anomalies encountered when porting data from the old to the new platforms. A ‘working’ dataset covers a two-year period between December 2016 and October 2018. New registrations were running at an average of around 20,000/month, whereas people were leaving

the service at less than 1,400/month, i.e. 7% of new users. When combined with the number of users already on the service as at November 2016 this gives an estimate of 550,000 active users as at November 2018. The majority of users (75%) were signed up as pregnant women, 12% were general information-seekers, and 3% were supporters of one type or another. There is a peak in registrations of pregnant women at the three-month mark, which coincides with the first trimester of pregnancy.

Data on the opt-outs suggest that if women used the system throughout their pregnancy, then they liked it and continued to use it in motherhood. Opt-out data tend to confirm the TFNC hypothesis that women who were assisted with registration might have a stronger commitment to the service, stay on the service for longer, be more likely to read the messages, and be more likely to adopt improved behaviours.

Business models and sustainability

Under the current arrangement, the mHealth Tanzania-PPP is funded by public money (from international donors), and the service is enabled by the charitable donation of SMS messages by the MNOs. The costs of developing the Wazazi Nipendeni service were covered by the US Centers for Disease Control and Prevention (CDC), as part of its public health programmes. The costs of developing the additional nutrition content were covered by the mNutrition programme. The service is funded and regarded as providing a public good, which it undeniably is.

In the case of Wazazi Nipendeni, it is difficult to argue a case for financial viability of the mHealth Tanzania-PPP because none of the partners generates revenue directly from providing the Wazazi Nipendeni service. Indeed, all parties are prohibited from generating direct revenue because the Government of Tanzania has ruled that all health services should be free to consumers. However, the quantitative research has found that ARPU increased among users, so it is possible to develop a business case for MNOs to provide an mHealth service on the basis of indirect benefits, should this be the model that is transferred to another country. Two hypothetical commercial models have been explored in detail:

- **Commercial content provider**: This speaks to the opportunity for replicating an mHealth agency, delivering a service similar to Wazazi Nipendeni, in another country. At 100% revenue share with MNOs (i.e. all TZS 510/user/month in increased ARPU goes to the content provider), the model suggests the service would break even at the beginning of Year 3. However, the rate of return on investment over a four-year time horizon would be negative. Given the assumed trajectory of growth in user numbers, much greater revenues are generated if the timescales can be extended. Therefore, at 100% revenue share, the service could generate a positive internal rate of return (IRR) of 4% over a six-year period. However, rate of return is highly sensitive to revenue share: at 90% revenue share (i.e. the MNO retains only 10% of the increase in ARPU), the IRR turns negative.
- **MNO in-house service**: There is also a hypothetical business case scenario in which an MNO in another country sets up an mHealth service in-house. The key differences from the commercial content provider scenario considered above are that the MNO would retain all of the additional revenue generated, and there would be no real costs associated with the SMS messages sent. If SMS messages and unstructured supplementary service data (USSD) sessions are zero-rated, then the service would break even in Year 3, although it would not generate enough cash to provide a positive return on investment over a four-year period. Assuming the same trajectory of increasing users, the large number of users (rising to 1.1 million) would generate enough revenue to provide a 19% IRR in a five-year period. However,

it should be noted that Wazazi Nipendeni, as a PPP, has gained users across all four MNOs and it is not clear whether an MNO in-house service would reach as many users.

Wazazi Nipendeni is offered as a national service available through multiple networks and does not, therefore, have a particular poverty focus. An MNO providing a service has the flexibility to charge SMS and labour at cost price (or lower), which is important for free or low costs services. Reach is, however, limited to customers of the MNO. In a balanced, competitive market, third party models can buy SMS from multiple MNOs, which increases their reach in underserved areas where only one network is available. Reach is also increased where third party providers enter into agreements with implementing health agencies that focus on vulnerable communities in rural areas (B2B models).

Voice-based services (e.g. outbound dialling) can overcome literacy and language constraints among the extreme poor but are expensive. The extreme poor could also benefit from emerging data based services that use audio and video but these are also expensive and there is a danger that they may require a level of digital literacy skills that would render them inaccessible. It would appear, therefore, that SMS is the only viable option for free services where minimising cost of sales is crucial.

Conclusions

- The Wazazi Nipendeni service offers a strong value proposition to users. It is highly valued by users: over 80% of households read the content they received, over 90% of users found the messages useful, satisfaction levels were high, and over 80% self-reported implementing at least one tip. The quantitative study found that accessing the Wazazi Nipendeni service had modestly improved a range of nutritional outcomes, most notably diets among young children.
- Field partners play a crucial role in providing a face-to-face presence that supports users by getting registered, reinforcing messages, and enhancing the effectiveness of the service.
- SMS remains an appropriate channel for delivering information to women. SMS may be particularly well suited to the Tanzanian context, given that literacy levels are relatively high (for sub-Saharan Africa), and the country is united by the language of Swahili.
- It is important to target men with awareness-raising so that they are more likely to permit partners to access phones. However, it is less important to enrol men as users on the system.
- The mHealth Tanzania-PPP will need to adopt the most effective channel for reaching the next generation of users, given increasing use of smartphones, social media, and the internet.
- As Wazazi Nipendeni can trace its roots back to Voxiva in 2001, the study highlights the importance of a long history of investment, partnerships, and political commitment in nurturing a facility to the point where it can successfully implement an information dissemination service (and other services) at national scale.
- The ability to broker a complex set of partnerships with a diverse range of stakeholder groups has been crucial to the success of the service. These partnerships have been successful due, at least partly, to the personal skills of the mHealth Tanzania-PPP team.
- The Wazazi Nipendeni service yields substantial indirect benefits to mobile operators in terms of increased ARPU. The effect size had in the quantitative study was at least a 10% increase in ARPU (TZS 510/month), and is likely to be higher still at national scale. This is as a result of women becoming more confident in their use of phones. There was no evidence that Wazazi Nipendeni users held on to their SIM cards for longer (reduced churn).

- Demonstrating that Wazazi Nipendeni generates real revenue for operators opens up possibilities for alternative commercial business models. Analysis has focused on two hypothetical cases representing opportunities for replicating an mHealth agency, delivering a service similar to Wazazi Nipendeni, in another country. An in-house mHealth service developed by an MNO appears to be the most attractive proposition for two key reasons. Firstly, all of the increase in revenue is retained by the MNO, and secondly, the real cost to an operator of sending SMS messages is minimal. Based on an initial investment of £312,500 to cover the cost of product development (UX research, monitoring and evaluation, content localisation), a scenario based on positive assumptions on operating costs, ARPU and the effect size (increase in ARPU), indicates that a service could provide an IRR of approximately 70% over a four-year period.
- Less attractive, although possibly still viable, is an independent content provider model; the provider would need to pay a bulk SMS price for all messages sent, and it would need to share revenue with each participating operator. A scenario based on positive assumptions on operating costs, ARPU and the effect size (increase in ARPU), and revenue share (50%) indicates that a service could only provide a positive IRR over a 6-year period. However, it is unlikely that an aggregator could convince an MNO to share 'increased ARPU' – as an indirect benefit; tracking and allocating such would be a challenge.
- The business model continues to be a multi-sided platform business model that provides value to funders with a health mandate (Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC) and CDC), who pay for the service, thereby enabling users to access it free of charge. As the MoHCDGEC assumes responsibility for more of the activities conducted by the mHealth Tanzania-PPP, the business model will tend towards a hybrid of a government-to-citizen model and the multi-sided platform.
- Despite vulnerabilities of the current business model to continued funding from CDC, and free SMS messages donated by MNOs, the model articulated by the mHealth Tanzania-PPP appears to be sustainable. The mHealth Tanzania-PPP continues to enter into agreements with new public health programmes, recent policy documents suggest that continued donor funding is likely to be forthcoming, and negotiations with CDC for renewed donor funding are at an advanced stage. There may be merit, therefore, in the donor funded business model.
- In the event that a health information service provider is permitted to levy charges (e.g. in other countries), possible mechanisms for revenue generation include charging NGO/ government clients, sponsoring of messages as a form of advertising (e.g. by fast moving consumer goods (FMCG) companies), and commission from sales of private health sector financial products (e.g. life insurance).
- Telecommunications companies have come under pressure from the Government of Tanzania as part of its anti-corruption campaign. Companies have been required to make shares available to the Tanzanian public, and several mobile companies have been charged with a range of charges, including tax evasion. Support for Wazazi Nipendeni has political capital in this context, and operators have now signed agreements directly with MoHCDGEC, rather than indirectly with the mHealth Tanzania-PPP. Previously, operators' promotion of Wazazi Nipendeni has been weak so they should be supported to capitalise on the positive brand of Wazazi Nipendeni.
- Although SMS remains an appropriate medium for reaching women, data-based services may split the market. Emerging mHealth services exploit the potential of the internet, of smartphones, of data acquisition and analysis, and of mobile money services. This is consistent with trends in the telecoms market of growth in data and mobile money. mHealth

services will need to be agile as they incorporate emerging technologies into their service offering.

Table of contents

List of figures and tables

List of abbreviations

Aids	Acquired Immune Deficiency Syndrome
API	Application programming interface
ARPU	Average revenue per user
CCBRT	Comprehensive Community Based Rehabilitation in Tanzania
CDC	US Centers for Disease Control and Prevention
COUNSENUTH	Centre for Counselling Nutrition and Health Care
CSR	Corporate social responsibility
DFID	UK Department for International Development
DHS	Demographic and Health Survey
EGPAF	Elizabeth Glaser Pediatric AIDS Foundation
FASTA	Fast-track Antiretroviral (ARV) Refills Scheme
FCDO	Foreign, Commonwealth & Development Office
FMCG	Fast moving consumer goods
GAIN	Global Alliance for Improved Nutrition
GCP	Global Content Partnership
GDP	Gross domestic product
GSMA	GSM Association
HIV	Human Immunodeficiency Virus
HPHB	Healthy Pregnancy, Healthy Baby
ICT	Information and communication technologies
IDS	Institute of Development Studies
IFPRI	International Food Policy Research Institute
ITT	Intent to treat
IVR	Interactive voice response
IYCF	Infant and young child feeding
JHCCP	Johns Hopkins Center for Communication Programs
LATE	Local average treatment effects
MNO	Mobile network operator

MOHSW	Ministry of Health and Social Welfare (Tanzania)
MoHCDGEC	Ministry of Health, Community Development, Gender, Elderly and Children (Tanzania)
NACP	National AIDS Control Programme
NBS	National Bureau of Statistics
NGO	Non-governmental organisation
NHIF	National health insurance fund
OECD	Organisation for Economic Co-operation and Development
OPM	Oxford Policy Management
OTT	Over the top
PEPFAR	President's Emergency Plan for AIDS Relief
PPP	Public–private partnership
SBCC TWG	Social and Behaviour Change Communication Technical Working Group
SIM	Subscriber Identity Module
SMS	Short Messaging Service
TB	Tuberculosis
TCRA	Tanzania Communications Regulatory Authority
TFNC	Tanzania Food and Nutrition Centre
TTCM	Text to Change Mobile
TTCL	Tanzania Telecommunications Company Limited
TZS	Tanzania shillings
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USSD	Unstructured supplementary service data
UX	User experience
VAS	Value added services
WHO	World Health Organization

1 Introduction

1.1 mNutrition

mNutrition is a global initiative supported by FCDO, managed by GSMA, and implemented by in-country MNOs and third party providers to use mobile technology, that sought to improve the health and nutritional status of children and adults in the developing world. The potential to utilise mobile technology to change attitudes, knowledge, behaviours, and practices around health and agriculture for improved nutritional status has been recognised for some time, but to date there have been no rigorous evaluations of m-services at scale. A consortium of researchers from Gamos, IDS, and IFPRI were contracted to conduct a rigorous mixed-methods evaluation to estimate the impact of mNutrition on children and adults, and to understand how the context and the components of the mNutrition intervention shape its impact.

In Tanzania, the service, Wazazi Nipendeni, focused on the provision of nutrition and health information and services to vulnerable pregnant women and caregivers of children under the age of five on their mobile phones, with the goal of improving nutrition outcomes and behaviours for mothers and young children.

1.2 Objectives

The mNutrition evaluation intends to understand and measure the impact, cost-effectiveness, and commercial viability of the mNutrition product using a mixed-methods evaluation design. The evaluation includes a quantitative component, a qualitative component, and a business model analysis. The evaluations were conducted by a consortium of researchers from Gamos, IDS, and IFPRI. The team drew on a number of methods and interlinked workstreams to gather evidence about the impact of the mNutrition intervention in Tanzania:

- a **quantitative impact evaluation**, employing a cluster randomised controlled trial to determine the causal effect of the service;
- a **qualitative impact evaluation**, which consists of three qualitative data collection rounds (i.e. an initial exploratory qualitative study, in-depth case studies at midline, and rapid explanatory qualitative work after the quantitative endline survey data collection), which aims to provide an understanding of the context, underlying mechanisms of change, and the implementation process of mNutrition; and
- a **business model and cost-effectiveness evaluation** employing stakeholder interviews, commercial and end-user data, document analysis, and evidence from the quantitative and qualitative evaluations to generate a business model framework and to estimate the wider imputed benefits from the VAS for the range of stakeholders involved.

The mixed-method evaluation design aims to address the following research questions specified in the terms of reference (Annex A):

1. What are the impacts and cost-effectiveness of mobile phone-based nutrition and agriculture services on nutrition, health, and livelihood outcomes, especially among women, children, and the extreme poor?
2. How effective are mobile phone-based services in reaching, increasing the knowledge, and changing the behaviour of the specific target groups?

3. Has the process of adapting globally agreed messages to local contexts led to content that is relevant to the needs of children, women, and poor farmers in their specific context?
4. What factors make mobile phone-based services effective in promoting and achieving behaviour change (if observed), leading to improved nutrition and livelihood outcomes?
5. How commercially viable are the different business models being employed at country level?
6. What lessons can be learned about best practices in the design and implementation of mobile phone-based nutrition services to ensure (a) behaviour change and (b) continued private sector engagement in different countries?

1.3 Research questions of the business modelling component

The business model and cost-effectiveness component of the evaluation is designed to contribute evidence to help answer the first of the broad research questions specified in the terms of reference (Annex A), and can be considered as specific to the following research questions:

- What are the impacts and cost-effectiveness of mobile phone-based nutrition services on nutrition, health and livelihood outcomes, especially among women, children and the extreme poor?
- How commercially viable are the different business models being employed at country level?
- What lessons can be learned about best practices in the design and implementation of mobile phone-based nutrition services to ensure (a) behaviour change and (b) continued private sector engagement in different countries?

The mNutrition intervention is being externally evaluated in two countries. In Tanzania, where the research consortium is evaluating mNutrition within a broader mHealth service, the intervention aims to promote behaviour change around maternal and early childhood health and nutrition. The target group of the quantitative component was therefore comprised of pregnant women and caregivers of children under the age of five years who reside in rural areas of the study region (Iringa). In Ghana, the intervention was implemented via an mAgriculture programme in which nutrition information has been integrated with crop information as part of a package of agriculture support services. The target group were low-income farmers in rural areas throughout the country. The terms of reference refer to the impacts and effectiveness of mobile phone-based services, so the scope of the evaluation is the mobile-based service as deployed under the mNutrition programme, rather than the incremental impact of support provided through the mNutrition programme. For the quantitative sample of pregnant women and caregivers of young children in rural Iringa that were selected to participate in the quantitative study, the evaluation focuses on estimating the causal effect of access to the mNutrition service.

The business modelling relies on other components in the evaluation study. To determine whether the mNutrition programme in Tanzania was meeting its stated objectives and targets, the quantitative impact evaluation employed a cluster randomised controlled trial to determine the causal effect of the service. That is, the evaluation identified how nutrition-related behaviours, knowledge, and outcomes were altered for service beneficiary households relative to their counterfactual levels: it sought to determine what the value of the outcome would have been for beneficiary households in the absence of access to the mNutrition service. While the quantitative evaluation was designed to produce evidence to contribute to the broader research consortium's answers to the first two questions listed in the terms of reference, IFPRI also specified a set of primary and secondary research questions that were answered using information collected by the quantitative research team. For each of the primary and secondary research questions, the evaluation focused on estimating the causal impact of the offer of access to the mNutrition service

and of registration for the mNutrition content among households induced to participate in the service by the treatment offer. The primary research questions addressed through the quantitative evaluation were:

1. What is the impact of the mNutrition service on women's dietary diversity?

2. What is the impact of the mNutrition service on IYCF practices?

3. What is the impact of the mNutrition service on nutritional status for children under 12 months of age at baseline?

The three primary research questions specify the main outcomes that were studied under the quantitative component of the evaluation. These directly contribute to answering the first overall study question of the mNutrition evaluation (see Section 1.2, above). The impact questions feed into the cost-effectiveness analysis presented here.

The intended audience for the business modelling endline report is FCDO, along with other organisations involved in mNutrition and mHealth programmes globally (including local MNOs and non-governmental organisations (NGOs) implementing mNutrition services), national governments—in particular, MoHCDGEC and TFNC in Tanzania—international agencies and donors, and community-level health workers. It should also be of interest to MNOs that are implementing or considering implementing a similar service. The reports from the evaluation will be publicly available on IFPRI's and IDS's websites.

1.4 Purpose and scope of the business modelling endline report

This report is a milestone in the evaluation study: it documents the journey of the Wazazi Nipendeni service in Tanzania supported by GSMA (and FCDO) over the duration of the evaluation. The report is one of four endline deliverables. This report should be read in conjunction with the baseline business modelling report (Batchelor *et al*., 2017), the endline cost-effectiveness report (Batchelor *et al*., 2019), and the quantitative endline report (Gilligan *et al*., 2019), which provides evidence of the impact of access to the service on both primary and secondary outcomes. The qualitative endline report (Barnett *et al*., 2019)[2] gives additional insights into consumer priorities and behaviours and how the service was used.

The baseline business modelling report covered the initial data gathering stage (up to March 2017). At this point, the GSMA grant was finishing, but the service continued to develop as it had had received direct funding through the mNutrition programme, so progress was in no way dependent on the mNutrition support.

The findings from the four endline deliverables described above will be combined and triangulated in a workshop planned for 2020. The two-day workshop will examine the insights from the quantitative, qualitative, cost-effectiveness, and business modelling components of the evaluation and will be attended by the lead partners from IDS, IFPRI, and Gamos responsible for each of these components. The main purpose of the workshop will be to disseminate learnings from the impact evaluation in Tanzania.

[2] This qualitative research report is commonly referred to simply as the 'qualitative research' throughout this report.

1.5 Organisation of the report

Section 2 describes the mNutrition intervention in Tanzania while section 3 describes the broader evaluation design. The business modelling narrative tracks changes that have occurred during the course of the study, and the reasons behind the decisions made, so Section 4 starts by reviewing the thinking behind the mNutrition programme and by exploring the history of the mHealth Tanzania-PPP. The business modelling canvas is reviewed in Section 5, partly by summarising findings from the baseline report, but enhanced with further details gathered in the intervening period. The mHealth Tanzania-PPP managed to source registration data requested by the team, and so, based on these data, the analysis presented in Section 6 provides insights into growth trends, how people use the service, and the importance of partners. Estimates of active user numbers from this analysis form the basis of the financial model used to explore the financial viability of the current business model, as well as hypothetical scenarios that represent possibilities for setting up a similar service in another country (Section 7). Telecoms is an important and dynamic market, and Section 8 presents an overview of key developments that have taken place during the study period, focusing on the political economy and technical developments. Finally, Sections 9 and 10 present a discussion of key issues raised in the report, along with a set of conclusions and learnings.

2 The mNutrition intervention

The mNutrition initiative is a five-year global programme supported by FCDO, managed and supported by GSMA, and implemented by in-country MNOs and third-party organisations, that seeks to use mobile technology to improve the health and nutritional status of children and adults in low-income countries around the world. The mNutrition initiative was implemented through existing mAgri and mHealth programmes in 12 countries throughout sub-Saharan Africa and South Asia. The nutrition content aimed to promote behaviour change around key farming practices and around dietary and child feeding practices likely to result in improved nutritional health within a household.

In Tanzania, the mNutrition service that is the focus of the evaluation and of this report was an integrated programme that enhanced an existing SMS-based health communication campaign targeting pregnant women and mothers of young children, known as HPHB. The mass media programme accompanying the service is called Wazazi Nipendeni. The Wazazi Nipendeni programme is a CDC-funded project bringing together multiple partners contributing towards shared goals. Phase 1 of the service, launched in 2012, was initially developed in coordination with the Tanzania Capacity Communication Project, a United States Agency for International Development (USAID) funded service led by JHCCP. Wazazi Nipendeni is one of several behaviour change services using methods as diverse as TV drama series, radio distance learning for community health volunteers, and several integrated mass media campaigns. The mass media campaign was developed by JHCCP, while the SMS component of the campaign is led by the mHealth Tanzania-PPP. The PPP was initiated by MoHCDGEC, with financial support from CDC. Wazazi Nipendeni is available nationally and on all phone networks.

The HPHB SMS service sent free text messages with healthcare information to pregnant women, mothers with newborns, and male supporters and general information-seekers in Tanzania to drive health-seeking behaviour. The SMS messages were sent in Swahili, to women up to 16 weeks post-partum on a range of pregnancy and early childhood issues, timed to coincide with the stage of the pregnancy and the age of the child. Anyone interested in receiving healthy pregnancy information can text the word ‘MTOTO’ (child) to the short code 15001. Registrants receive instructional messages, allowing them to indicate the woman’s current week or month of pregnancy (or the age of the newborn baby) during the enrolment process. This process allows the recipients to receive specific text messages relevant to the time and stage of pregnancy or early childhood. The message frequency also varies depending on the life stage of the woman and child, ranging from nearly daily during key periods of pregnancy to less than weekly for mothers of children over the age of two. Nutrition-related content was a small component of the original HPHB SMS service but was expanded substantially with the addition of the content contributed through GSMA under the mNutrition service. mNutrition added roughly 120 nutrition messages, which are delivered to mothers or caregivers of children up to five years old. At the beginning of the study period, HPHB and mNutrition were available to households in all regions of Tanzania, on all mobile phone networks. Participating individuals receive the text messages free of charge. The resulting product is referred to as the mNutrition service in the remaining sections of this report.

The 120 nutrition messages included in the mNutrition service were drawn from 42 factsheets on nutrition-related behaviours identified as key determinants of outcomes that were developed by the Global Alliance for Improved Nutrition (GAIN) together with local partners: the Centre for Counselling, Nutrition and Health Care (COUNSENUTH) and Every1mobile. The information contained in these factsheets was then adapted to the context of Tanzania and made mobile-ready by the local content providers under the guidance of MoHCDGEC and TFNC. As a part of the adaptation process, the message content was tested with potential users in Tanzania, after which

the language and substance were adjusted and messages that were identified as not being useful were removed from consideration for the final service. The message testing process highlighted the importance of replacing technical terminology that was likely to be unfamiliar to the message recipients with language that was more commonly used but that still conveyed the evidence-based content of the original factsheets. Included in the final service are messages that encourage the consumption of iron folic acid tablets during pregnancy and messages that promote vitamin A-rich complementary feeding practices, and the inclusion of animal source foods in young children's diets, as well as messages providing information on other behaviours accepted as being critical determinants of nutrition outcomes. For more details on the intervention, see the baseline report (Gilligan *et al.,* 2018).

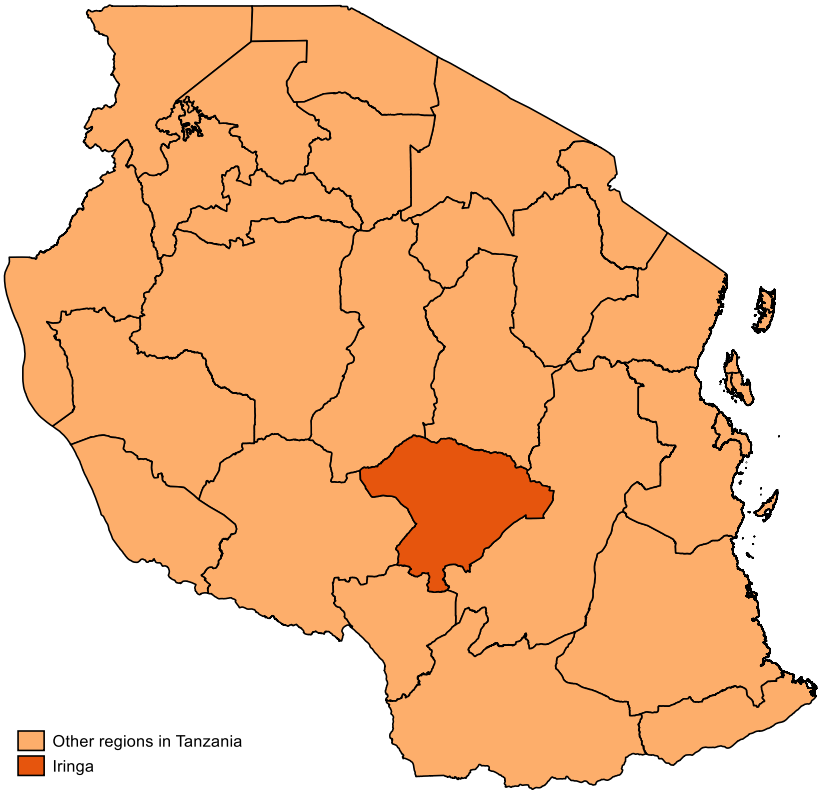
2.1 Study region context

The United Republic of Tanzania is an East African nation with an estimated population of 57.3 million (2016), 68% of whom reside in rural areas (World Bank, 2018). As at 2018, 64% of working-age males and 69% of working-age females were employed in agriculture (International Labour Organization, 2018), with the main agricultural export commodities including tobacco, cashew nuts, coffee, cotton, and sesame seed (Food and Agriculture Organization of the United Nations, 2018). Tanzania is divided into 31 regions and regions are further subdivided into a total of 169 districts. Child undernutrition is a pervasive problem in Tanzania, particularly among young children. In the 2016 DHS, 34.4% of children under five were identified as being stunted (height-for-age z-score below -2). Wasting is less common, with only 4.4% of measured children under five having a weight-for-height z-score below the -2 threshold. Over half (57.7%) of measured children between 6 and 59 months of age are anaemic (DHS, 2016).

The quantitative and qualitative components of the evaluation took place within the three rural districts of the Iringa region in Tanzania: Iringa rural, Kilolo, and Mufindi. Figure 1 displays the location of Iringa region in Tanzania. Iringa became an independent region in 1964, before which it was a part of the Southern Highland Province. As at the 2012 Population and Housing Census, the total population of Iringa region was estimated to be 0.9 million, 73% of whom resided in a rural area. Agriculture is the primary means of livelihood for most households in the rural parts of Iringa region: roughly 89% of households in Iringa rural, 92% of households in Mufindi, and 92% of households in Kilolo are involved in agriculture. At the time of the census, average household size was 4.2 and the adult literacy rate was 79% among the rural population (Population and Housing Census, 2012). In Tanzania more broadly, child undernutrition is a severe problem in Iringa. 41.6% of children under the age of five in the 2016 DHS were stunted. This figure was nearly 7 percentage points higher than the national average, suggesting child malnutrition may be more prevalent in Iringa than elsewhere in Tanzania. Additionally, 3.6% of children under five were wasted and 40.3% of children aged 6–59 months of age were anaemic.

In part, Iringa was selected as the location for the study because of a dearth of existing relationships between mHealth Tanzania-PPP and organisations with a presence in the region. Consistent with this, the mNutrition baseline qualitative report found that households in study villages typically rely on health workers at local health clinics and community health workers for their nutrition information needs. Often the information from health clinic workers is received during antenatal visits, which also involve the provision of non-nutrition-related information, testing, and other services, sometimes leaving little time for issues related to nutrition (Barnett *et al.*, 2017). Though at the start of the study there was limited availability of nutrition information and nutrition services, the Government of Tanzania has prioritised improving nutrition outcomes nationwide through different initiatives—see more detail in the baseline report (Gilligan *et al.*, 2018).

Figure 1: Iringa region in Tanzania



Source: Gilligan *et al*., (forthcoming, 2020

2.2 Summary of the quantitative component approach

The quantitative evaluation was designed as a cluster randomised control trial, with two stages of randomisation: a village-level randomisation where villages were assigned to a treatment group or to a control group, and a household-level randomisation within treatment villages whereby households were either assigned to receive the mNutrition content on just the mobile phone of the primary female or on the mobile phones of both the primary female and the primary male. In villages that were assigned to the treatment group, sampled households were offered access to the mNutrition content on their mobile phone, free of charge, through a door-to-door, in-person visit. In villages that were assigned to the control group, no offer of access to the service was made. Though registration for the mNutrition service was possible for all households regardless of treatment assignment, pre-baseline discussions with the organisation implementing the mNutrition service in Tanzania suggested that take-up of their existing service was low in the study region.

From the randomly selected sample of villages participating in the evaluation, IFPRI randomly assigned households in half the villages to a treatment group (T)—where sampled households received a door-to-door offer of access to the content—and households in the other half of participating villages to a control group (C) that did not receive a similar offer. Because the assignment of villages was random, any average difference in outcomes between households in the two groups can be attributed to the difference in access to the mNutrition service.

In addition to the village-level randomisation, the evaluation also included a second-stage household-level randomisation within treatment villages: households in treatment villages where both the mother of the young child or pregnant woman (the primary female) and the primary male own distinct mobile phones (and were surveyed) were randomly allocated to either just receive the

mNutrition content on the mobile phone of the primary female (T-F), or to receive the mNutrition content on the mobile phone of the primary female and the mobile phone of the primary male (T-F+M). By comparing behaviours and outcomes between treatment households in the T-F+M group and those in the T-F group, and contrasting both the T-F and the T-F+M group to households in control villages that would have been eligible for the household-level randomisation, it was expected that learning would be generated about how information flows between spouses.

2.3 Summary of the qualitative component approach

The sample selection for the qualitative study was purposive and based on the quantitative baseline data. Three sites were selected from the sample of 90 treatment villages. At community level, the main data collection tools were semi-structured in-depth interviews with treatment mothers and fathers (i.e. mothers and fathers who were signed up to receive Wazazi Nipendeni plus mNutrition messages) by the Oxford Policy Management (OPM) Tanzania team during the quantitative baseline survey, key informant interviews, and focus group discussions with treatment mothers and fathers and elderly women. In-depth interviews were conducted with mothers who had signed up to receive the Wazazi Nipendeni mNutrition service on their phone or their partners' mobile phone as part of the baseline survey. In-depth interviews were also conducted with fathers whose partners were signed up to the service, who received messages on behalf of or in addition to their wives. Key informant interviews were conducted with influential and knowledgeable people in each village, including village chairmen and/or community health workers. The purpose was to explore their knowledge, awareness, and opinions of the mNutrition messages that people in the community had been receiving, and to capture information on current contextual issues relating to maternal and child nutrition. Focus group discussions were carried out with four or five participants per group. The aim was to select heterogeneous groups of mothers (by occupation, age, number of children) who had signed up to the Wazazi Nipendeni plus mNutrition service.

3 Evaluation design

3.1 Study design

This report is constructed based on interviews with key stakeholders and access to secondary data. A list of contacts made can be found in Annex B.

The study has used the Osterwalder and Pigneur framework to structure insights into the business model (Osterwalder and Pigneur, 2010). Few business models in the 21st century are straightforward and simple. Production of a product, sales of the product, and revenue from that product are only a part of the overall model. Revenues are often made based on associated advertising, or on the value the product adds to the brand. The landscape report published as part of this study details some of the possibilities for MNOs (Barnett *et al*., 2016).

In this report, we use the Osterwalder and Pigneur canvas as a basis for the analysis. An introduction to the framework is given in Annex C. While this generally works well, we acknowledge that the canvas is good for taking a snapshot of business models, but in this report documenting the timeline and history of the product is important. These business model insights are intended to answer the key research question: 'How commercially viable are the different business models being employed at country level?'

In a development sector in which public funds are increasingly under scrutiny for value for money, the rollout of a public good via a private sector commercially sustainable mechanism is very attractive. The heart of the question just quoted is predicated on assuring that future actions taken by donors and the private sector regarding similar products are informed and lessons are learned, in order to increase the chances of sustainability. Hence, while we try to use the Osterwalder and Pigneur framework in an applied manner, there are times when we have documented the 'back story' that lay behind certain decisions.

The aim of the baseline report was to provide a detailed description of each of the building blocks of the business model canvas as at the time of the beginning of the independent study. That report also provided a review of operating experience since the beginning of the mNutrition project, on the basis that that may have provided the context for changes that had taken place in the product design. This report builds on the baseline, bringing the canvas up to date.

3.2 Data collection methods

The endline report is based on information collected from multiple sources:

- qualitative interviews conducted with stakeholders and MNOs in Tanzania;
- commercial data provided by stakeholders and MNOs (or brokered by GSMA);
- monitoring data gathered by Altai;
- data available in published literature;
- additional, unpublished information on costs and business models from government stakeholders and alternative service providers;
- the quantitative component of the study, led by IFPRI (Gilligan *et al*., 2019); and
- the qualitative component that focused on consumer perceptions, led by IDS (Barnett *et al.*, 2019).

3.2.1 Processing information

Evaluation activities carried out by Gamos to inform the endline reports included the following:

- Field visits to establish and maintain relationships with key stakeholders. Interviews conducted with key representatives of stakeholder institutions to gather additional data to populate the Osterwalder and Pigneur framework. Ongoing communication and field visits undertaken to monitor developments in services and to track the commercial justification for changes.
- Populating the Osterwalder and Pigneur canvas with information gleaned from reports previously published under the mNutrition programmes (e.g. UX testing, case studies, rapid feedback surveys, etc.), as well as grey literature.
- Working with IDS and IFPRI to contribute to the design of both qualitative and quantitative instruments (both baseline and endline) to incorporate indicators relating to non-financial attitudes of customers to services, and to MNOs in particular, such as customer satisfaction and brand loyalty. These instruments also explored attitudes towards alternative services offered by other providers, e.g. media, face-to-face extension.
- Interviewing alternative service providers to explore alternative business models (among alternative mobile services).
- Analysing financial data with a view to creating a financial model to test key cost sensitivities.

The process of enquiry and information collection was flexible and responsive to events on the ground, given that the service offerings were constantly evolving (e.g. the publication of significant outputs from the research project). This component of the evaluation is therefore based on opportunistic gathering of data from key individuals, such as representatives of the core partners and other partners to the project.

3.3 Ethical considerations and approval

As an overall guiding principle, the research team sought to conduct themselves in a professional and ethical manner throughout the work, with strict respect for the principles of integrity, honesty, confidentiality, voluntary participation, impartiality, and the avoidance of personal risk. These principles were informed by the Organisation for Economic Co-operation and Development (OECD) (2010) Development Assistance Committee Quality Standards for Development Evaluation and FCDO's 'Ethics Principles for Research and Evaluation', which have been followed for the duration of the evaluation.

Overall, this component draws on the qualitative and quantitative data collected in the other two components of the evaluation, which have their own ethical protocols. The key business modelling data sources are stakeholder interviews with MNOs and data collection (commercial and monitoring data) from MNOs and other relevant organisations.

Although most research participants were familiar with the mNutrition programme, and with the principle of an independent evaluation, this component sought to obtain the informed consent of participants. This was achieved by sending them emails and briefing documents describing the research. In particular, we described the relationship between the consortium, FCDO, and GSMA, in order to avoid any possibility of deception. Research activities with participants involved interviews only; there were no observational activities.

While this evaluation component has not involved any primary data collection from human subjects at community/ household level, ethical considerations are still considered important for all work carried out under this component. In particular, GSMA remain highly aware of the commercial sensitivities of their partner MNOs, so the issue of commercial confidentiality is very important for this area of work, given that it relies on the sharing of sensitive commercial data. Therefore, the Gamos team has paid specific attention to this issue as part of their ongoing work.

The Gamos team is currently operating under the non-disclosure agreement signed by GSMA and OPM during the inception phase of the project. Where relevant, stakeholder respondents were informed that a non-disclosure agreement with their trade association has been signed, and that the interview was bound by it. All the data being gathered fell within the scope of this agreement (e.g. development, business plans, marketing, operations, and finances) although there is a provision that such information should be designated as proprietary or confidential.[3]

For the avoidance of doubt, all internal reports shared by Gamos were marked as confidential and were not to be circulated outside of the evaluation team. Any outside reporting will not contain any detail that could be construed as proprietary or confidential information.

All external reports were and will be shared with key research participants in early draft form in order to establish principles of trust and reciprocity. This is to ensure that participants have an opportunity to confirm that their views have been reported accurately, and that publications do not breach their confidentiality requirements.

As this component draws on qualitative and quantitative data collected through the other two workstreams, appropriate measures were taken to ensure that the shared data are anonymised and there is no risk of confidentiality breach. For the quantitative data, a unique household ID has been assigned to each household which allows for following up with respondents as necessary without providing access to any personal information on datasets that are made available for analysis. Similarly, all qualitative transcripts are anonymised and pseudonyms given, and any information that can lead to personal identification has been removed.

3.4 Limitations

The methodology relied on the willingness of key stakeholders to share their data and their thoughts. In a commercial environment, this is not always forthcoming, and a limitation of the report is that it relies on these shared data. Risks associated with this transfer of data have been mitigated as much as possible by clear communication and follow-up with stakeholders. Sensitivities among the major mobile operators, along with structural changes and turnover of staff, made it difficult for GSMA and the study team to build relationships with MNOs. Changes in relationships and personnel (among all stakeholders) were the principal threats to the mitigation strategy. The mHealth Tanzania-PPP has been instrumental in securing the data used in the report.

[3] The agreement permits Gamos to share confidential information among the team if: 1. they need to know; 2. they have entered into a confidentiality agreement; and 3. they are not a competitor.

4 Wazazi Nipendeni – the background

4.1 The vision for mNutrition

The original GSMA (and FCDO) vision was to create something different in mHealth. They had seen many mHealth pilots that utilised mobiles and smart devices to strengthen the health system of various countries and to offer a consumer-facing product at scale. Many pilots existed, but few if any, scaled activities that were coordinated with the health service nationwide. The terms of reference state that under the mNutrition programme, GSMA was to provide assistance to MNOs and partnerships to scale up services (Annex A); FCDO's vision, then, was to create a service that could achieve scale by being made available to MNO subscribers.

GSMA's original vision was for a convening space, or clearing house, which any party interested in providing health-related services could subscribe to. The complexion of the institution that would manage the clearing house was not specified. It could be some kind of collaborative membership organisation, or it could be managed by a private sector organisation, typically an aggregator (it would anyway require an aggregator to set up the links to each of the MNOs in the country). The key feature of this vision was that it would lower the barriers of entry to mHealth services – the infrastructure and agreements with MNOs would already be in place so any institution wishing to set up an mHealth service could use the arrangement to send mobile-based information at relatively low cost. By creating a focal point for mHealth services operating within the country, it would also promote coordination, collaboration, and sharing of resources, thereby helping to address the all too frequent complaint of duplication of effort. By devolving responsibility for content, including the nature of the services to be made available by participating organisations, the concept had the potential to support the dissemination of diverse content, and to support innovative mechanisms for reaching resource-poor mobile phone users.

The system was expected to work as follows:

1. The managing institution would secure a short code valid on all networks.
2. The first time users would dial into the system, they would be guided through a series of menus and questions to complete their profile. They would then be routed to relevant information based on their profile (e.g. gender, pregnant mother, or mother of child under two). Once routed to relevant menus, they would be presented with options regarding which type of information they wanted to receive, and within that type of information, they could choose from relevant content providers.
3. Once they had chosen the content provider, the profiling information would be sent to that content provider, and the user would be signed up to that partner's service (which may or may not include further profiling).

Services were to be made available on a freemium basis, i.e. certain information was to be available to users for free, and they would need to pay for other, premium content. The nutrition messages, generated as part of the GSMA mNutrition programme, were to be made available as free messages.

In early 2015, GSMA was negotiating with Green Telecom, a Tanzanian private sector company that had been founded just over a year earlier, about a role as a nutritional messaging service. It appeared to offer a good fit with the kind of partner that GSMA was looking for, as it had links to each of the mobile operators, and was in the business of developing low-cost mobile solutions to enable its clients to reach consumers. The company was formed as a result of a merger between an aggregator and a platform developer, so it had all the technical skills needed. In the end,

however, GSMA entered into a partnership with Wazazi Nipendeni, which had a proven track record in delivering SMS content to mothers.

The original concept was ambitious, and centred around getting potentially competing organisations to collaborate, which is a time-consuming business. Eventually, timescales conspired against that concept, and in the first wave of countries, GSMA entered into what might be regarded as more conventional partnerships with mobile operators. The partnership in Tanzania with the Wazazi Nipendeni product is something of an exception to this rule, as it is hosted by a PPP that, although it has agreements with mobile operators, is independent of any single MNO.

4.2 History of Wazazi Nipendeni

Voxiva was founded in 2001 as a disease surveillance system that enabled health workers to submit local reports of disease outbreaks using a phone. This was one of the earliest examples of an ICT-based innovation developed to solve a developing world problem. The system enabled real-time data collection, data analysis, and dissemination of response information (back to health workers in the field). Initially set up in Peru, the Voxiva system was later replicated in Africa. When the PEPFAR programme was launched in 2003, it partnered with Voxiva as part of a consortium in Rwanda (Casas and Lajoie, 2005).

Voxiva then provided a link from early, pioneering work on exploiting mobile technology in public health to the subsequent Phones for Health programme. PEPFAR was keen on working with PPPs as a mechanism for achieving its objectives, and it set up seven multi-country PPPs in 2007 (PEPFAR, 2008), one of which was ‘Phones for Health’. Phones for Health was a PPP between Accenture Development Partners, GSMA, Motorola, MTN, and Voxiva. All funding initially came through PEPFAR but was administered by CDC. Other organisations involved in the PPP included the USAID Private Sector Engagement Unit and the Organisation for Global AIDS Co-ordination. Although the PPP was originally intended to be implemented in 10 countries, only Kenya and Tanzania signed up and committed funding.

In Tanzania, activities were transitioned from Voxiva to local organisations in 2009. The transition was facilitated through CDC, with management oversight from Phones for Health. In 2010 the Phones for Health programme issued a call for interest in creating a local PPP for mHealth in Tanzania. The CDC foundation described Phones for Health as a pilot, and this next step was intended to bring services to scale. In 2011 the name of the local PPP then changed from Phones for Health to the mHealth Tanzania-PPP. CDC managed the mHealth Tanzania-PPP from 2009 to 2015 and then contracted Cardno to manage the mHealth Tanzania-PPP under a five-year agreement covering the period 2015–2020.

GSMA has played an instrumental role in the development of the mHealth Tanzania-PPP. It was one of the original partners in the Phones for Health partnership (in 2007). GSMA twice nominated the programme as one of the five most successful mobile health interventions, and it was selected for an award in 2014. This was important as the profile helped to secure the support of mobile operators for the service. CDC views the mHealth Tanzania-PPP as a success story, as it is rare to see a successful transition from a centrally held programme to a country-held PPP, and especially one in which there is a true partnership with the national ministry of health.

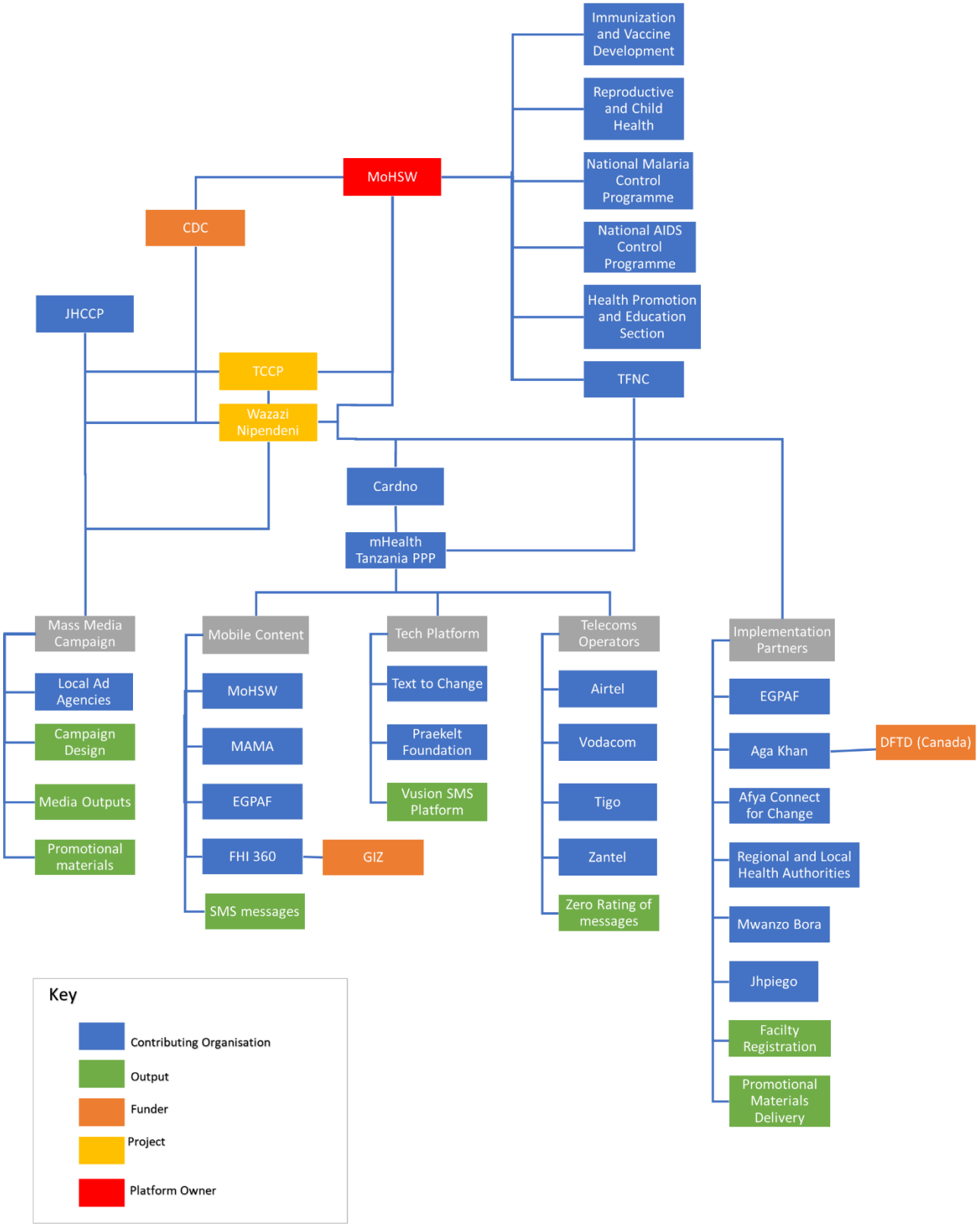
4.3 Partnerships

The mHealth Tanzania-PPP evolved as a group with expertise in brokering partnerships, which are a defining feature of the Wazazi Nipendeni service. Partners fall into a range of categories (represented in Figure 2):

- MoHCDGEC – Multiple departments within the ministry have convened various initiatives supported by Wazazi Nipendeni throughout its evolution. TFNC is currently operating as a core partner in the mHealth Tanzania-PPP, which provides synergy with the expanded nutrition content provided by the mNutrition programme. Wazazi Nipendeni, as an mHealth service, offers a good fit with MoHCDGEC's eHealth Strategy, and supports the Government of Tanzania's commitments under the Open Government Partnership.
- Content providers – Over the course of multiple initiatives, various organisations, mostly NGOs, have assisted with the development of content to augment the Wazazi Nipendeni database; this includes a number of MoHCDGEC departments.
- Mass media organisations – These have worked with content partners to generate multimedia outputs; this was largely funded by JHCCP under the Tanzania Capacity and Communications Project.
- Telecoms partners (Airtel, Tigo, Vodacom, and Zantel) – These provide zero-rated SMS messages at the heart of the system. This represents the largest single cost item of the service, if valued at market rates for SMS messages. The four largest MNOs in the country have partnered with Wazazi Nipendeni; messages are funded through their corporate social responsibility (CSR) departments and the Vodafone Foundation.
- Technology platform – The service was originally facilitated by the open source Vusion platform provided by TTCM, originally a non-profit.[4] However, this system had a number of shortcomings, many of which were a consequence of the technical setup. In October 2016, the system migrated to a new platform commissioned by MoHCDGEC, funded by CDC, and provided by a Tanzanian company, Rasello.
- Implementing partners – These are operational organisations running health campaigns in various parts of the country. The content provided by Wazazi Nipendeni supports their campaigns. Their field presence enables them to enrol people in the system.

[4] Text to Change has since changed its status to a for-profit social business.

Figure 2: Organisations involved in Wazazi Nipendeni



Source: Authors

The original Wazazi Nipendeni text messaging service did not have the capability to deal with voice messages, but voice messages were developed as part of the local content development process in Tanzania. Under a separate agreement, GSMA subsequently commissioned HNI (now Viamo) to incorporate the mNutrition content into its 321 service, provided in partnership with Vodacom

Tanzania. In contrast to Wazazi Nipendeni, the 321 service is a 'pull' type of service, whereby users dial a short code and navigate through interactive menus to find the information they are seeking. The system mostly plays audio clips to users, rather than sending SMS text messages. 30 interactive voice response (IVR) scripts were selected to be integrated into the 321 health service, and were recorded.

4.4 Developments in Tanzania

The revised Wazazi Nipendeni service, including the additional nutrition messages incorporated under the mNutrition programme, was officially launched by the Minister of Health, Community Development, Gender, Elderly and Children during World Breastfeeding Week in August 2017.[5]

In line with the strategy articulated at the baseline, MoHCDGEC continue to assume greater responsibility for functions previously carried out by the mHealth Tanzania-PPP, especially the technical operations. The mHealth Tanzania-PPP continues to work closely with MoHCDGEC staff in the field, and estimates that there are roughly 1,700 health workers currently active in promoting and registering women onto the system. The Rasello platform is a tool that is paid for and used by MoHCDGEC. The mHealth Tanzania-PPP continues to be responsible for the technical management of the platform. The ICT Unit in MoHCDGEC have responsibility for a wide range of digital tools used in different aspects of health services, not only those that use mobiles to disseminate information to clients. MoHCDGEC programmes that are now using mobile services developed by the mHealth Tanzania-PPP include the following:

- National Aids Control Programme (NACP) – Fast-track Antiretroviral (ARV) Refills Scheme (FASTA), PEDAIDS (Elizabeth Glaser Pediatric AIDS Foundation (EGPAF) programme).
- National Tuberculosis and Leprosy Programme – TB self-assessment (PATH and Cardno). The mHealth Tanzania-PPP developed and manages two TAMBUA TB apps[6] that enable users to carry out self-screening and information dissemination. Diagnosed TB patients can be registered by health workers to receive treatment adherence messages. The mHealth Tanzania-PPP is working to integrate records with the national electronic TB and leprosy register system. At the moment, anybody reached by the PATH programme will have to fill in personal details, but if they also attend a government health facility, they will have to fill in another paper form with the same details. Integrating data systems will avoid creating duplicate data.
- TFNC – The dissemination of nutrition information using mobiles (Wazazi Nipendeni) is an integral part of the Tanzanian Government's progress in scaling up nutrition-specific interventions (Scaling up Nutrition, 2018).
- Reproductive and Child Health Section – Wazazi Nipendeni disseminates information to pregnant women and mothers.
- Electronic Integrated Disease Surveillance and Response (e-IDSR). The development and rollout of the mobile reporting tool was led by the MoHCDGEC Monitoring and Evaluation Unit. The Digital Health Roadmap to 2023 calls for resources to fund a national scale-up from 17 regions (MoHCDGEC, 2017).
- National Blood Transfusion Text Messaging Service, led by the National Blood Transfusion Services.

[5] https://scalingupnutrition.org/wp-content/uploads/2019/03/TANZANIA-JA-2018-EN.pdf
[6] https://ntlp.go.tz/posts/ntlp-launch-the-tambua-tb-m-health-applications/

- National Feedback Mechanism for health services (public feedback on health services provided). The Digital Health Roadmap to 2023 recommends investing in the electronic client feedback platform.
- An early infant diagnosis system (HIV).

The mHealth Tanzania-PPP's relationships with MNOs has changed. Originally, the mHealth Tanzania-PPP signed agreements on behalf of MoHCDGEC but now MNOs are changing to sign agreements directly with MoHCDGEC. For example, Tigo and Halotel have signed new agreements to provide zero-rating of messages with the ministry, rather than with the mHealth Tanzania-PPP. Funding from Vodacom is transitioning from the Vodacom Foundation to the commercial Vodacom company, which will also be entering into an agreement with the ministry. This reflects a growing awareness among MNOs of the value of their support for Wazazi Nipendeni, which is important to them given the current political climate (see Section 8.1). This shift is consistent with the sustainability plan of the mHealth Tanzania-PPP to transfer responsibilities to government agencies.

Rapid staff turnover within the telecoms industry continues to pose a challenge for the work of the mHealth Tanzania-PPP. For example, there was a change in leadership at Tigo and responsibility for Wazazi Nipendeni was transferred to a completely new team, which changed the CSR priorities to education and financial inclusion so that Tigo wanted to discontinue support for Wazazi Nipendeni. It is likely that this was linked to changes in the company structure following the acquisition by Tigo of a majority stake in Zantel (see Section 8.2). The mHealth Tanzania-PPP, with the support of a nutrition officer from MoHCDGEC, had to put a lot of effort into convincing the new Tigo team of the value of Wazazi Nipendeni, and eventually secured an agreement to continue their support. Similarly, after time and effort had been invested in building relationships with the CSR contact at Airtel, that contact then moved on.

The mHealth Tanzania-PPP continues to run public awareness campaigns from time to time. When it runs a particular campaign that is sponsored by a particular MNO it has to make sure the promotional materials only have the sponsoring MNO branding. Some MNOs put a limit on the number of messages that they will donate in a year. This will cause increasing difficulties given the current registration growth trend evident in Figure 9.

Under the arrangement with Rasello, MoHCDGEC departments and MNOs have been given their own dashboards so they can access up-to-date predefined metrics on registrations. However, even the dashboard furnished to the mHealth Tanzania-PPP only gives access to predefined metrics, meaning it does not have direct access to the back-end database. Any request for non-standard reports requires a specific request to be made to Rasello to construct a query (there is no additional cost for these requests).

The 2018 PEPFAR country operation plan acknowledges the importance of the role that the mHealth Tanzania-PPP plays in leveraging the support of MNOs. The plan pledges to further expand its activities with the mHealth Tanzania-PPP and emphasises the leadership role of government agencies: 'Expand mHealth PPP and support implementation and expansion of Fast-Track ARV refills (FASTA) initiatives under NACP and MOH leadership' (PEPFAR, 2018).

Although the current management contract with Cardno is due to expire in 2020, negotiations between the mHealth Tanzania-PPP and CDC for a subsequent phase are already at an advanced stage. It is proposed to divide responsibility for the suite of products currently supported by the mHealth Tanzania-PPP between three main partners:

- Ministry of Health

- Management Development for Health (MDH), a Tanzanian NGO providing research and services on public health
- Management Sciences for Health (MSCH), a public health non-profit working in over 150 countries,

This will provide continuity of funding from CDC, as CDC is a major donor to both of these 'management' programmes. It is expected that a new management contract will go out to tender, possibly for a further 5 years, as is typical for CDC funded programmes.

Looking to the future, there is a growing recognition of the role of nutrition in HIV programming. Good nutrition is important for people who are HIV positive, and good nutrition is required for ARV therapies to be successful. Therefore, nutrition is becoming a larger part of overall HIV support packages. In terms of technology, GSMA and the mHealth Tanzania-PPP were keen to develop the service to include IVR, which it was thought would improve reach into poorer communities with lower levels of literacy, and would enable users to actively seek information rather than passively receive SMS messages. However, this proved not to be popular when they trialled it and MNO partners remain reluctant to zero-rate IVR calls. Nevertheless, they would like to try again with the technology. Another idea for providing two-way communication is to work with partners who can provide a call centre facility. The mHealth Tanzania-PPP is considering ways of exploiting the reach and power of social media, which is becoming increasingly popular among young men and women.

5 Review of the business model

5.1 Introduction

This section is structured around the Osterwalder and Pigneur canvas building blocks. This section summarises key observations made in the baseline report, supplemented with additional findings from the intervening period, as well as findings from both the qualitative and quantitative studies. An introduction to the canvas and a more detailed description of Wazazi Nipendeni as it relates to the framework are provided in Annex C.

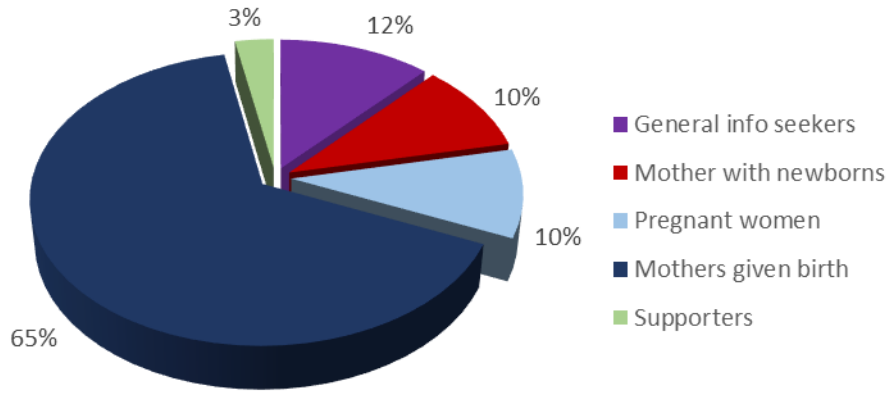
5.2 Customer segments

At registration, users are allocated to one of four categories:

- pregnant women;
- mothers with newborns;
- supporters (of pregnant women or young mothers); and
- general interest.

The registration database provided by the mHealth Tanzania-PPP covers users registered onto the system during a two-year period from November 2016 to November 2018. During this time, many women who were originally registered as pregnant women had given birth, and were then re-categorised on the system as mothers with newborns. Figure 3 shows that these women make up the vast majority of active users.

Figure 3: Mix of active users (as at November 2018)



Source: Authors

- Phone ownership and access are key to accessing the Wazazi Nipendeni service. Having at least one household member that owned a phone was part of the screening criteria for the quantitative study, so it cannot provide any insights into linkages between the service and phone ownership.

- In terms of access, men were reluctant to let their wives have phones, fearing they would be used to facilitate affairs, and women themselves recognised that phone ownership can cause problems in the family because of trust issues. Among young, married women, who

are the primary customer segment, it tends to be husbands who control their access to phones, either through consent to ownership, by buying a handset/ SIM for their wives, or by sharing their own phones with their wives.

- The qualitative study highlighted the importance of enlisting men's support for (if not participation in) the Wazazi Nipendeni service as a means of facilitating women's access to content. For example, the quantitative study found that women's access to Wazazi Nipendeni messages was less reliable if husbands received the messages, as they often did not share them with their partners. They also found that men often disagreed with some content, particularly that on family planning, in which case they would withhold access to the messages and would not share information with their partners.

- As a national service that is available through multiple networks, Wazazi Nipendeni is available all across the country, wherever there is network coverage. It does not, therefore, have a particular poverty focus. However, the majority of users were signed up by field partners, who tend to focus programmes on rural and low income communities.

5.3 Value proposition

The aim of the original Wazazi Nipendeni multimedia campaign was to encourage women to avail themselves of health services targeted at improved neonatal health outcomes. Content had been developed over a number of previous partnerships, each of which had a slightly different thematic focus, including:

- prevention of mother-to-child transmission of HIV/Aids;
- antenatal care;
- family planning;
- malaria prevention;
- nutrition (for mother and baby);
- danger signs;
- having an individual birth plan; and
- post-partum care.

The GSMA mNutrition project strengthened the service by contributing substantial additional nutrition content. Added content covered life stages up to five years.

A key feature of the GSMA mNutrition programme content generation process was the procedures put in place to ensure quality of information. TFNC was instrumental in ensuring that the content was accessible and consistent with national nutrition strategies. UX research was conducted early on in the project to ensure that messages were appropriate, how they might fit with different types of consumers (the archetypes), and how to improve the customers' experience of the service:

- GeoPoll tested a small sub-sample of messages for comprehension and relevance.

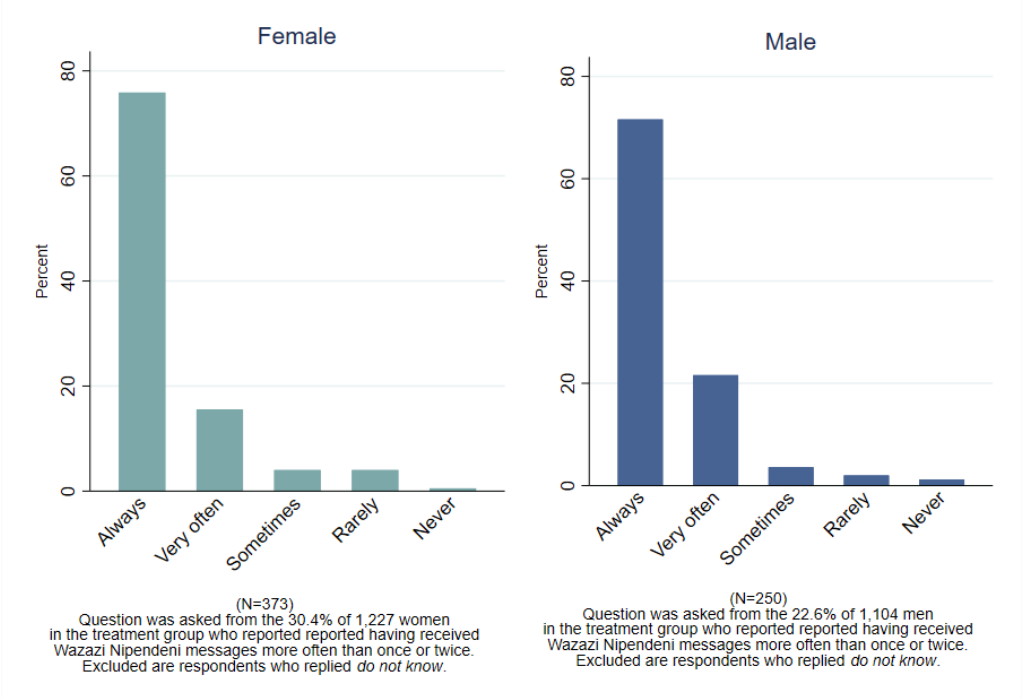
- ThinkPlace conducted user focused research using human-centred design principles.

- Frog later conducted further UX research based on in-depth interviews.

Evidence from the quantitative study appears to confirm the quality of messages. Value and satisfaction metrics among treatment household members were high:

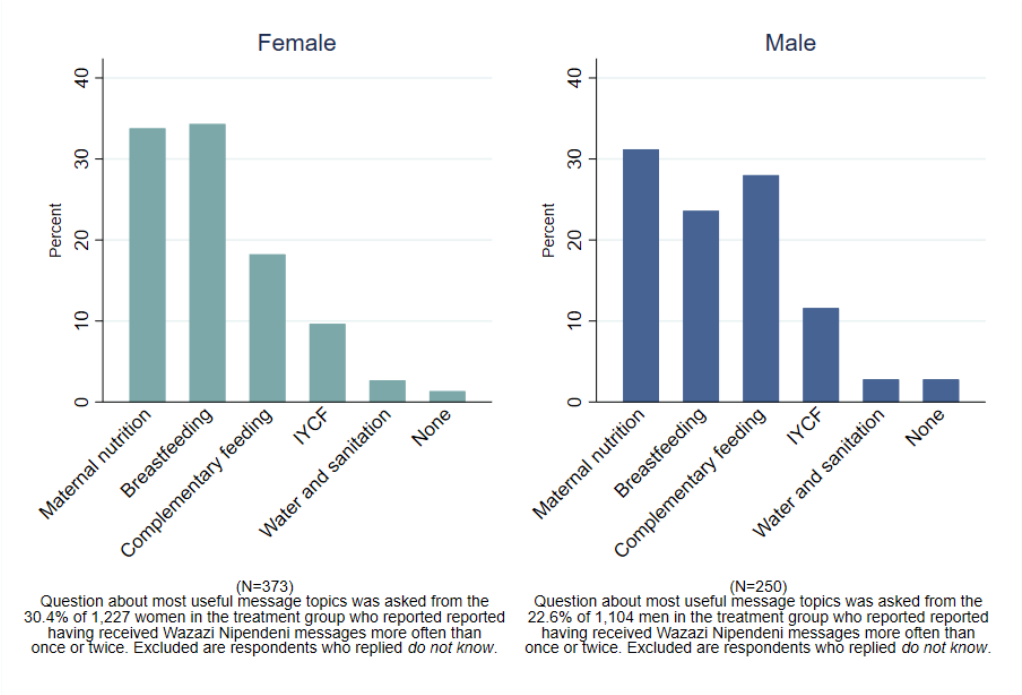
- Between 82.7% and 91.6% of households read all the mNutrition content they received.
- Over 90% of users either always or very often found the messages useful (see Figure 4). Figure 5 shows that information on maternal nutrition was regarded as most useful (but not by a large margin).
- Over 90% of users (93.5% of females and 92.2% of males) would recommend the service (likely or highly likely).
- 89% of females and 81% of males self-reported implementing at least one tip.

Figure 4: How often was the mNutrition content deemed to be useful?



Source: Gilligan *et al*., (forthcoming, 2020)

Figure 5: Most and least useful mNutrition message topics, by gender



Source: Gilligan *et al*., (forthcoming, 2020)

Findings from the quantitative study appear to confirm that users did indeed change their behaviours, as it found that accessing the Wazazi Nipendeni service had improved a range of nutritional outcomes. Diets among young children in the treatment sample had improved, as follows:

- Dietary diversity for children aged 6–35 months – The number of food categories consumed increased by 0.107 (p-value 0.073).
- The likelihood that children aged 6–35 months met the minimum dietary diversity – Children in the treatment communities were 3.8 percentage points more likely to have consumed from four food groups (p-value 0.093).
- Children aged 6–23 months in the treatment communities were 6.9 percentage points more likely to satisfy minimum acceptable diet.

Diets among women of reproductive age (primary females) had also improved:

- The likelihood that the primary females satisfied **minimum dietary diversity for women** had increased by 4.0 percentage points (p-value 0.062).

Secondary outcomes relating to knowledge and behavioural practices had also improved:

- There were improved knowledge of IYCF practices among men.
- There was a statistically significant impact on the combined household-level measure of nutrition knowledge.

5.4 Channels

In the 2015 Tanzania DHS survey 53% respondents had heard of Wazazi Nipendeni. Note that the five year TCCP programme started in 2010 and finished in 2016, so the DHS survey will have been conducted when the programme had achieved nearly maximum reach. Radio was clearly the single channel that achieved greatest reach: 87% of people had heard about Wazazi Nipendeni from the radio (Table 1). About a quarter of respondents had heard about the campaign on the television, with another quarter doing so through printed media (poster/ magazine/ newspaper/ billboard).

Table 1: Responses to question 'How did you hear about the Wazazi Nipendeni campaign?'[7]

How did you hear about Wazazi Nipendeni?	Frequency (n=5,398)	%
Radio	4,710	87%
Television	1,463	27%
Poster/ magazine/ newspaper/ billboard	1,186	22%
Family/ friend	582	11%
Community health worker	459	9%
Health facility	421	8%
Does not know/ remember	80	2%
Mobile phone	61	1%
Internet	17	0%
Other	1	0%

Source: Authors' own, based on DHS dataset (accessed September 2019)

During the initial campaign as part of the Tanzania Capacity and Communication Project (TCCP), printed materials were distributed to a range of health facilities where women come into contact with health professionals, e.g. hospitals, health centres, dispensaries. The mHealth Tanzania-PPP worked in partnership with the health sector, providing training for health professionals, who were then able to help women register on the system. There are three ways of registering for the Wazazi Nipendeni text messaging service (analysis can be found in Section 6):

- Assisted by health facility worker – women can be signed up when they come for antenatal care visits etc.
- Assisted by community health workers – community workers can sign women up when they visit them in their homes, or other local venues.
- Self-registration – instructions were given in the multimedia campaign. People dial the short code and then are guided through a small number of profiling questions (category of user, and stage of pregnancy/ age of child).

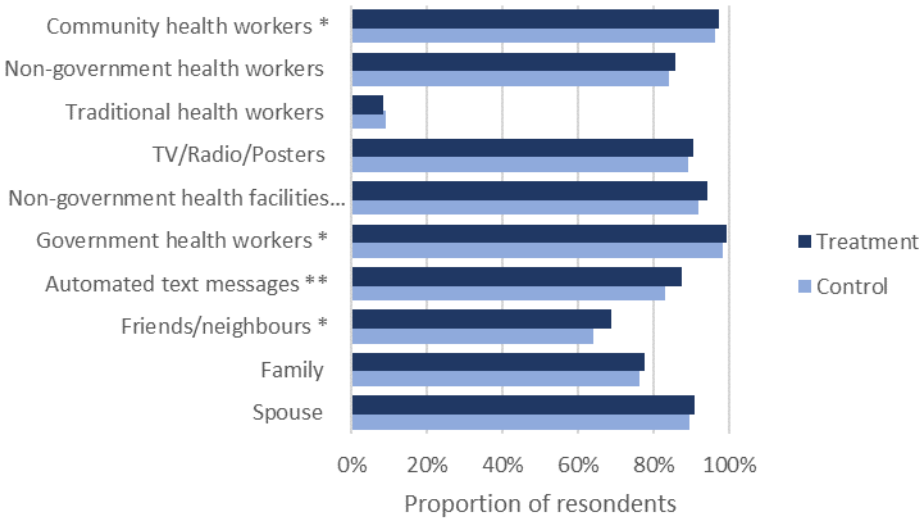
- Registration data show that 57% of users were registered by partners. It is not possible to determine exactly how many of the 'other' users actually registered by themselves, but 59% were registered using USSD, suggesting that they were in fact registered, or at least assisted by a health worker. This means that *up to* 83% of users were registered by partners. Although mass media channels can be effective in raising awareness of the Wazazi Nipendeni

[7] Multiple response – respondents may have heard of Wazazi Nipendeni through multiple channels, i.e. adds up to more than 100%.

campaign, it is face-to-face contact through partners that is instrumental in signing people up. TFNC also believes that people who register with a health professional will have a positive bias to comply with messaging, have a better understanding of how the service works, and be more likely to appreciate how they can benefit from the service.

Figure 6 confirms that health workers are the most highly trusted sources of information on health matters (government more so than NGO facilities). It is interesting to note that even among control communities, people have high levels of trust in information from automated text messages, confirming that text messages are regarded as being reliable and of high quality. Patterns of who people actually get information from (Figure 7) broadly reflect levels of trust, although they emphasise the importance of government health workers.

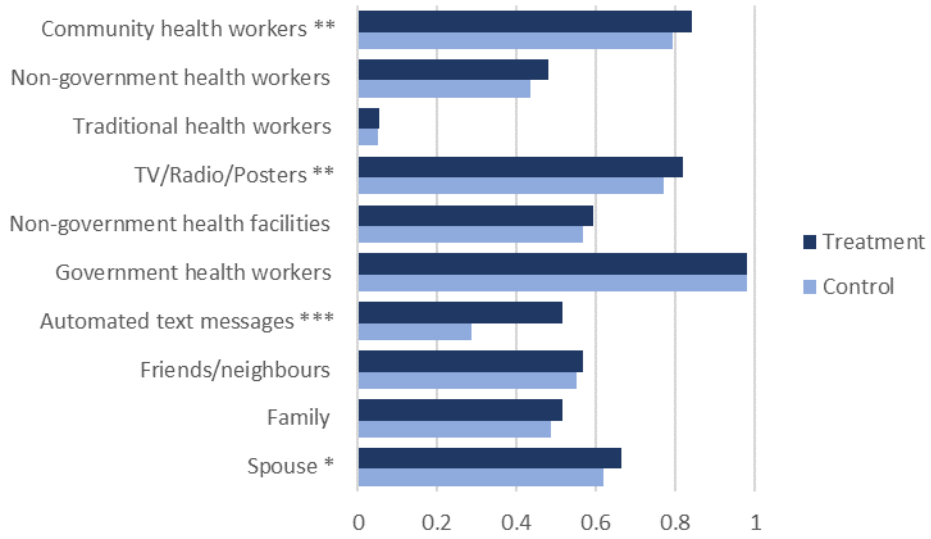
Figure 6: Trust in sources of health information[8]



Source: Authors

[8] Percent who agree they would trust information from each source.

Figure 7: Sources of health information



Source: Authors

The qualitative research identified a number of features of SMS messaging that fits well with women's lifestyles:

- text messages can be read repeatedly – audio messages may be heard incorrectly;
- as messages remain on the phone, they can be shared with friends and colleagues at any time; and
- text messages are private – they remain on the phone, which tends to be regarded as a personal device; audio messages can be overheard by others.

It should be noted that the SMS channel may be particularly well suited to the Tanzanian context, given that literacy levels are relatively high (for sub-Saharan Africa)[9], and the country is united by the language of Swahili.

5.5 Customer relationships

The aims of the customer relationships that Wazazi Nipendeni creates with users can be considered to be threefold:

- Acquisition. Those who were assisted with registration have quite a different relationship with the service to those who self-registered. Registration data confirm the importance of field partners; up to 83% of users were signed up by partners (see Section 5.4).
- Retention. Several features of the system minimise pain points that might prompt users to leave a system. The service is free of charge. The system only requires a user's pregnancy or maternal status to be gathered at registration. Content is regarded as relevant and of value. Retention levels are high; registration data indicate that the number of people opting out of the service is equivalent to roughly 7% of new users in a month.

[9] The adult literacy rate in Tanzania is 78%, compared to an average for sub-Saharan Africa of 64% (2015 data from https://data.worldbank.org).

- Compliance with improved health practices. High levels of satisfaction and perceived quality support high retention levels. Nearly 90% of those who self-reported having ever received the content read all messages received, and over 80% self-reported implementing at least one tip.

Wazazi Nipendeni has a strong brand, which is quite distinct from the MNOs that support the service, and users tend to view it as a MoHCDGEC service, as the Government pushed it through the media.

Given that most of the funding for the mHealth Tanzania-PPP comes from CDC, it can be argued that the most important relationship is that with CDC. Providing evidence that the service is delivering improved health outcomes is important.

5.6 Revenue streams and indirect benefits

Wazazi Nipendeni is free of charge to users, so there is no direct revenue stream. The service has also been made available free of charge to field partner institutions. In 2016 the mHealth Tanzania-PPP and TFNC held intense negotiations over whether or not Wazazi Nipendeni would be permitted to charge for these information services. In the end, the Government insisted that health information should be made available to citizens free of charge, which constrained opportunities for developing commercially sustainable business models. This is a national policy issue.

The mHealth Tanzania-PPP is currently funded by CDC, although the successful functioning of the service depends on contributions by various partner organisations. The service is, therefore, vulnerable to any withdrawal of funding from CDC. Current funding is planned to 2020. The service also depends on the zero-rating of text messages by partner MNOs.

There is no evidence that Wazazi Nipendeni has resulted in lower churn. The quantitative study found no difference in the length of time that respondents reported having had their main SIM card, there was no difference in the likelihood that they had the same primary phone number as they had at baseline (a two-year duration), and there was no difference in the proportion who subscribed to the same operator as at baseline.

ARPU was higher among users. Control households spent an average of TZS 5,300 per month (£1.90/month) on mobile phone airtime (including any data bundles), but spending was 10% higher (TZS 510, £0.18/month) in treatment communities. The qualitative study found this was due to women becoming more confident in using their phones.

The latest DHS data indicate that 53% of people (across the country) had heard of Wazazi Nipendeni (see Table 6). TCRA data for October 2018[10] give the total number of subscribers on the four partner networks as 41.0 million. Therefore, 550,000 Wazazi Nipendeni users represent 1.3% of the entire subscriber base. Although MNOs supporting Wazazi Nipendeni do not use the reach and positive brand of Wazazi Nipendeni in their promotional materials, they are beginning to recognise the political value attached to their support for Wazazi Nipendeni. By signing agreements to support Wazazi Nipendeni directly with the Government rather than with the mHealth Tanzania-PPP, MNOs are gaining recognition of the value of their contribution.

[10] www.tcra.go.tz/index.php/quarterly-telecommunications-statistics

5.7 Key resources

Key resources are defined as those assets required to create and offer the value proposition. The primary assets employed by the mHealth Tanzania-PPP in delivering the text messaging service are the content database and the applications platform that sends scheduled messages.

The current **content** comprises the pre-existing database brought by the mHealth Tanzania-PPP, and additional content generated through the mNutrition programme. This nutrition content is regarded as a public good, having been paid for by FCDO. In March 2019, CABI made this content publicly available under open access through its Knowledge Bank resource.[11]

The text messaging service originally ran on the Vusion **platform** developed by TTCM in partnership with the Praekelt foundation. In October 2016 Wazazi Nipendeni migrated to a new platform, created for MoHCDGEC by a local software developer (Rasello). The new platform is able to equip MNOs with their own dashboard so they can track the number of users and messages being sent.

The text messaging service is designed to serve as part of multimedia campaigns, so the **field partner** programmes and interventions are a key resource required to deliver the full potential of the value proposition. To date, 24 partners have assisted with registering users in the field (see Section 5.9).

The key 'resource' in convening these partnerships has been, and will continue to be, the partnership with TFNC and its linkages to both national nutrition policymakers and health and nutrition interventions launching in the country.

Early in 2019, the mHealth Tanzania-PPP appointed a new team leader. While the previous country manager came from a mobile technology background, the new team leader is a medical professional. This reflects the changing complexion of the PPP, as Government agencies take greater ownership of the platform along with associated technical responsibilities.

5.8 Key activities

In order to make the business model work, perhaps the most fundamental activity that needs to be undertaken is networking. Both TFNC and the mHealth Tanzania-PPP clearly have good personal contacts in order to broker partnerships with field NGOs, and to enlist the support of MNOs.

The Global Content Partnership was mandated to create higher-level, generic content, and little provision was made for creating specific, locally relevant messages. Under the original vision, it was expected that participating organisations would tailor global content to their own needs. When this idea was abandoned, additional funding was made available for Every1Mobile and COUNSENUTH to localise content.

TFNC was the government agency responsible for signing off content at the end of the content generation process. However, TFNC adopted a much more proactive role, and its involvement has continued to deepen throughout the project. When the content generation process was changed to facilitate the production of more detailed, localised content, TFNC got more involved. TFNC's engagement with and awareness of the programme played an important role in ensuring that signing-off procedures went smoothly.

[11] https://ckan.cabi.org/data/dataset/nutrition-knowledge-bank

Monitoring and evaluation is a key activity, as evidence of the contribution that Wazazi Nipendeni makes towards positive health outcomes will be instrumental in negotiating partnerships with forthcoming health interventions.

Providing a face-to-face presence when working with women is important for achieving positive behaviour change. The qualitative study found that messages acted as reminders to reinforce information provided by health workers, and to reinforce mothers' existing knowledge.

Registration, scheduling, and the dispatch of messages to users is handled by the technical platform. This is sub-contracted to Rasello, as the platform provider, and management is being gradually transferred from the mHealth Tanzania-PPP to MoHCDGEC.

Content will need to be regularly updated to keep it relevant, e.g. new drugs and products will be introduced, and recommended practice will be modified. People will quickly lose trust in information that is not immediately useful, or, even worse, wrong. One of the partners needs to be given the responsibility (and funding) for ongoing maintenance of content.

5.9 Key partnerships

The complex set of partnerships brokered by the mHealth Tanzania-PPP and TFNC is a defining feature of the Wazazi Nipendeni service. Partnerships have been crucial to accessing all the resources needed to make the service succeed:

- Research and design. Wazazi Nipendeni was originally conceived as a prevention of malaria in pregnancy campaign, following an analysis by JHCCP of the 2010 Tanzania DHS data. The mHealth Tanzania-PPP delivered the text messaging service as part of the campaign put together by JHCCP and MOHSW.
- Content. Content development for the SMS component of Wazazi Nipendeni was led by MOHSW, to ensure messages were developed in line with Government recommendations and delivered in line with timing guidelines provided by the World Health Organization (WHO). Further content was leveraged from the Mobile Alliance for Maternal Action.[12] Content on family planning was leveraged from Mobiles for Reproductive Health (m4RH).[13] Content for Prevention of Mother-to-Child Transmission was designed by EGPAF. TFNC was instrumental in securing the support of the SBCC TWG for nutrition in approving content.
- Technology platform. The service was originally run on the Vusion open source platform developed by TTCM. The system architecture led to problems with reliability, latency, and cost. The service was migrated to a new platform in October 2016. It was hosted locally by Rasello and was commissioned and paid for by MoHCDGEC (with CDC funding).
- Telecoms operators. The mHealth Tanzania-PPP had identified MNOs as key partners at the start. However, MNOs needed to be convinced of the viability of the concept before committing. The Wazazi Nipendeni campaign was launched without explicit support from MNOs, but after the service achieved 100,000 users within 11 weeks the MNOs entered into agreements.
- Field partners. The programme launched in November 2012 with a two-month nationwide media campaign (radio and TV). A follow-up campaign ran from July 2013 to February 2014, during which field partners promoted the service and assisted with registrations. In addition to the 24 field partners (see Table 9) that have formal agreements with the mHealth Tanzania-

[12] A PPP, launched in May 2011 by USAID and Johnson & Johnson, with supporting partners, the United Nations Foundation, the mHealth Alliance, and BabyCenter.
[13] A pilot project led by Family Health International 360 with MOHSW and funded by USAID.

PPP (and have a source code allocated on the system), other agencies have simply incorporated registering women onto Wazazi Nipendeni into their field processes. Analysis of registration data suggests that field partners may have assisted up to 83% of users to register.

- Government agencies. The Government of Tanzania is committed to a number of relevant health policies on nutrition, sexual and reproductive health, and maternal mortality, and to a number of information and ICT policies, including open and accountable government, and electronic access to health services.

5.10 Costs and investment

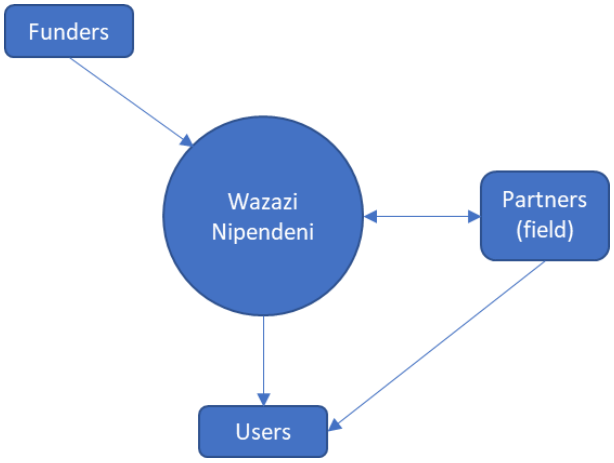
The baseline report presented set-up and ongoing costs covering a two-year period, mainly derived from costs reported by the mHealth Tanzania-PPP and GSMA. Now that more detail has been provided, these costs have been superseded by a more comprehensive and rigorous analysis, which is presented in Section 7.

In addition to those costs directly associated with the mHealth Tanzania-PPP (both operating and capital), FCDO and GSMA have invested in wider programmatic costs that stimulated and supported this action. It is worth noting that the mHealth Tanzania-PPP has a history of donations and in-kind contributions made over the years by the CDC and programme partners.

5.11 The business model

It is proposed that Wazazi Nipendeni is based on a multi-sided platform business model, which is commonly associated with IT businesses. This provides a means of making a product free to one group of customers, while another group pays. Wazazi Nipendeni brings together two groups, providing a link between funders, who pay for the service, and users who receive the service for free (see Figure 8). Funders with a health mandate benefit from improved health outcomes achieved by users. Field-level partners cannot really be considered a third side to the platform because they already have their own link to users through their field presence. The relationship with Wazazi Nipendeni can be considered as a simple business-to-business transactional arrangement as described – Wazazi Nipendeni provides a valuable service, and partners drive users to the system.

Figure 8: Key partnerships (business model)



Sources: Authors

The strengths and weakness of the business model can be summarised as follows:

- Partnerships are a key feature of the mHealth Tanzania-PPP's way of working, and have been instrumental in securing resources that have made the service a success. The PPP core team have continued to forge new alliances with field partners as they implement new health interventions. Links with the Government of Tanzania have been strengthened over the duration of the evaluation study as MoHCDGEC has assumed greater responsibility for the technical platform in particular.
- The viability of the model is vulnerable to discontinuity in revenue, i.e. it depends on CDC funding. On the one hand, five-year fixed-term agreements provide security, but on the other hand, the mHealth Tanzania-PPP is facing uncertainty now the agreement is shortly to expire. Nutrition content may not be a continuing priority for CDC, which focuses on HIV, tuberculosis, and malaria in Tanzania.[14] Now that it has been shown that the VAS generates substantial increases in ARPU, it may be possible to argue a case for some kind of revenue sharing agreement with MNOs; further research is required to explore viable mechanisms for this.
- The reach and brand of the service is attractive to field partners. DHS data showed that over half of adults were aware of Wazazi Nipendeni (in 2015), and the quantitative study found that 13% of people in the control sample had received messages from Wazazi Nipendeni.
- Wazazi Nipendeni offers a strong value proposition. Not only are quality metrics for the messages high (e.g. levels of trust, frequency of reading messages, customer satisfaction ratings), but users also report changing their behaviour, so the service is valued by users. The quantitative study has shown that the service is linked to improved nutritional outcomes (notably an increase in dietary diversity among infants), demonstrating value to partner health agencies, such as TFNC, and to donors, such as CDC. Indirect benefits in terms of increased ARPU provide a strong commercial basis to justify the in-kind contribution made by MNOs to the service.

[14] www.cdc.gov/globalhealth/countries/tanzania/default.htm

6 Analysis of users

6.1 Overview

The mHealth Tanzania-PPP submitted Wazazi Nipendeni registration data from the Rasello platform to the authors. The query was performed on 27 March 2019. A 'working' dataset covering a two-year period (11 November 2016 to 3 November 2018) addresses a number of data issues:

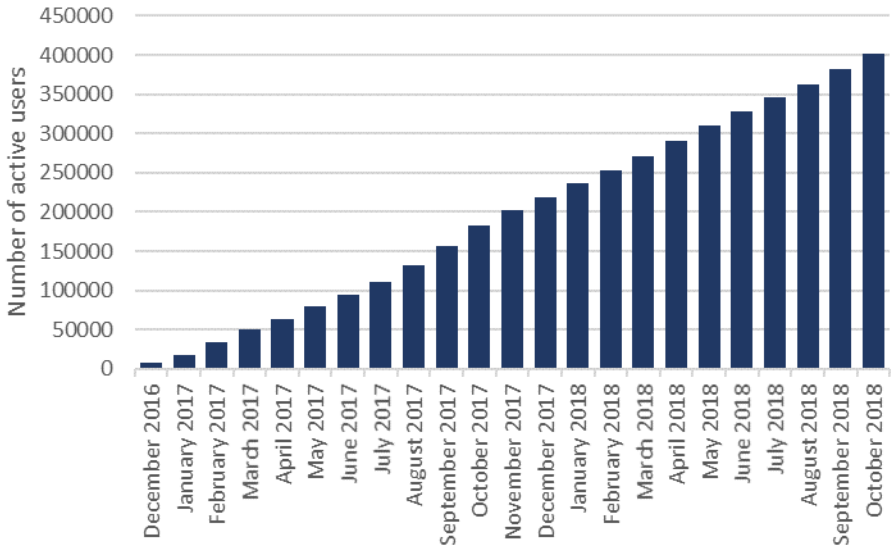
- Creating an additional category that represents women who registered when pregnant but have since given birth and have continued using the service as a mother with a child.
- Spikes in registrations. On 10 November 2016, the date when API registrations were adopted by multiple partners, and a spike in USSD registrations over a three week period in November 2018.
- Anomalies with opt-out dates, e.g. over 9,000 records were marked as having opted out on 3 April 2017.

The analysis in this section is supported by more detail given in Annex D.

6.2 Growth in user numbers

Both new registrations and opt-outs fluctuate monthly. In the period May 2017 – October 2018 new registrations were running at an average of around 20,000/month, whereas people were leaving the service at a much lower rate of less than 1,400/month, i.e. 7% of new users. Combining new users with people leaving the service gives the cumulative profile of active users presented in Figure 9.

Figure 9: Growth in active users



Source: Authors

In the absence of reliable data, it is not possible to track patterns of growth in users from the introduction of the service. The total number of users may be up to 130,000 higher than suggested by Figure 9, because many of the original users that were migrated onto the new system have not

been included in these numbers. Nevertheless, the patterns of growth and opt-outs remain accurate.

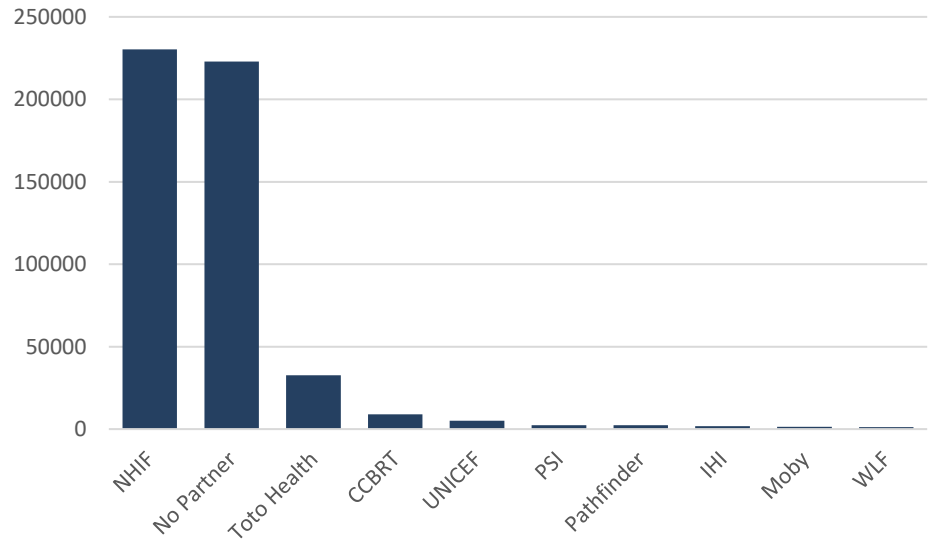
In November 2017, the mHealth Tanzania-PPP estimated the number of active users to be 350,000. This is consistent with the active user numbers in Figure 9, as adding 130,000 to the November 2017 estimate of 200,000 from the chart gives a total of 330,000, which is close to the mHealth Tanzania-PPP estimate. Making an assumption of straight-line growth in active user numbers, and assuming a starting base of 100,000 active users (rounded down), the number of active users after a two-year period (December 2016 to November 2018) is estimated at 550,000. This figure was validated by the mHealth Tanzania-PPP.

6.3 Understanding users and partners

The majority of users (75%) were signed up as pregnant women (sum of 'PW' and 'PW=>MC' categories in Figure 3). 12% were general information-seekers, and 3% were supporters of one type or another.

The NHIF has brought the largest number of users onto the system (Figure 10). Among the 11 partners that registered more than 1,000 users, all apart from UNICEF used either API or USSD exclusively (almost). None used the short code. When the USSD system was introduced, SMS remained the channel the general public could use to register. Among users registered with no partner, 62% registered using an API or USSD (Table 2) suggesting that many could well have been registered with the assistance of a field partner. It is not, therefore, possible to determine precisely how many users truly self-registered, i.e. without any assistance. Up to 83% of all users could have been registered with the assistance of some kind of partner if API and USSD registrations are included.

Figure 10: Registrations by partner



Source: Authors

Registration data provide some insights into the ways in which different programmes work. For example, the rate of registrations by NHIF was roughly constant, whereas self-registrations fluctuate widely as people respond to local and national campaigns.

There is a peak in registrations of pregnant women at the three-month mark, which coincides with the first trimester of pregnancy. Users who were supporting pregnant women also tended to sign up at the end of the first trimester. Users who registered as mothers (and supporters of mothers) mostly signed up within the first month after giving birth.

Most users leaving the system were registered as pregnant women and left before giving birth. The relatively low number of women in the 'PW=>MC' category leaving suggests that women who used the system throughout their pregnancy liked it, and then continued to use it in motherhood. The sub-set of data that represents users who have registered and then left the service is relatively small (n = 25,300).

TFNC hypothesised that women who were assisted with registration might have a stronger commitment to the service, stay on the service for longer, be more likely to read the messages, and be more likely to adopt improved behaviours. Table 2 sheds some light on the users leaving the service. While 12% of those registered by partners using USSD subsequently dropped out, only 0.3% of API registrations opted out. Only the general public continued to register using the short code, so only 38% of those with no partner can be classified as self-registered with some confidence. 42% of these users opted out, which provides some evidence to support the TFNC hypothesis.

Table 2: Registrations and opt-outs; assisted and self-registrations

	Source (for registration)				
	API	Excel import	Short code	USSD	Total
No partner					
Number registered (all)	6,508	973	84,257	132,431	224,169
% of total registrations	2.9%	0.4%	37.6%	59.1%	100.0%
Number opted out	1232	105	35132	42688	79157
% of total who have opted out	1.6%	0.1%	44.4%	53.9%	100.0%
% of source who have opted out	18.9%	10.8%	41.7%	32.2%	35.3%
Registered by partner					
Number registered (all)	233,364	4,898	0	53,062	291,324
% of total registrations	80.1%	1.7%	0.0%	18.2%	100.0%
Number opted out	796	27	0	6204	7027
% of total who have opted out	11.3%	0.4%	0.0%	88.3%	100.0%
% of source who have opted out	**0.3%**	**0.6%**	**0.0%**	**11.7%**	**2.4%**

Notes: Number opted out is based on records with a valid opt-out date (not necessarily from May 2017 onwards).

Source: Authors' own

7 Financial viability of business models

7.1 Overview of business models

In the baseline report (Batchelor *et al*., 2018), it was proposed that the relationships between key stakeholders could be regarded as a multi-sided platform business model. This provides a means of making a product free to one group of customers, while another group pays. When considering financial viability, the principal cost components are as follows:

Operating costs:

- mHealth Tanzania-PPP (offices, staff, servers);
- Government agencies (staff costs);
- SMS and USSD costs (MNOs); and
- field partner agencies (staff costs and expenses).

Fixed costs:

- developing content (Global Content Partnership and localising of content);
- mNutrition programme support (e.g. GSMA business intelligence); and
- developing the Wazazi Nipendeni service (mHealth Tanzania-PPP).

It is difficult to argue a case for the financial viability of the mHealth Tanzania-PPP because none of the partners generate revenue directly from providing the Wazazi Nipendeni service. Indeed, all parties are prohibited from generating direct revenue because the Government of Tanzania has ruled that all health services should be free to consumers. However, the quantitative research has found that the ARPU increased among users, so it is possible to develop a business case for MNOs to provide an mHealth service on the basis of indirect benefits (these are discussed in Section 5.6). If there is a commercial case for MNOs to provide an mHealth service, then there is a case for a third party to provide content on a revenue share basis (as with conventional VAS).

Under the current business model, MNOs made no investment in developing the Wazazi Nipendeni service, but they have donated the SMS messages and USSD sessions that the service depends on. Without any investment, standard financial metrics such as IRR or payback period are not relevant. In this case the contribution margin[15] gives an indication of financial performance, or the contribution that the product makes to group profit.

This analysis goes on to consider the financial viability of two scenarios:

- An independent but commercial content provider: The provider invests in localising content (assuming nutrition and maternal health content is in the public domain) and manages both the technical systems and arrangements with national health programmes (in the same way as the mHealth Tanzania-PPP). It provides information services as a VAS to MNOs on a revenue sharing basis.
- An in-house MNO service: The MNO invests in localising content (assuming nutrition and maternal health content is in the public domain) and sets up an internal product development

[15] Per unit revenue (indirect benefit) – variable costs. Contribution margin is often expressed as a percentage, when divided by the per unit revenue.

group to manage technical systems and to make alliances with national health programmes (in the same way as the mHealth Tanzania-PPP).

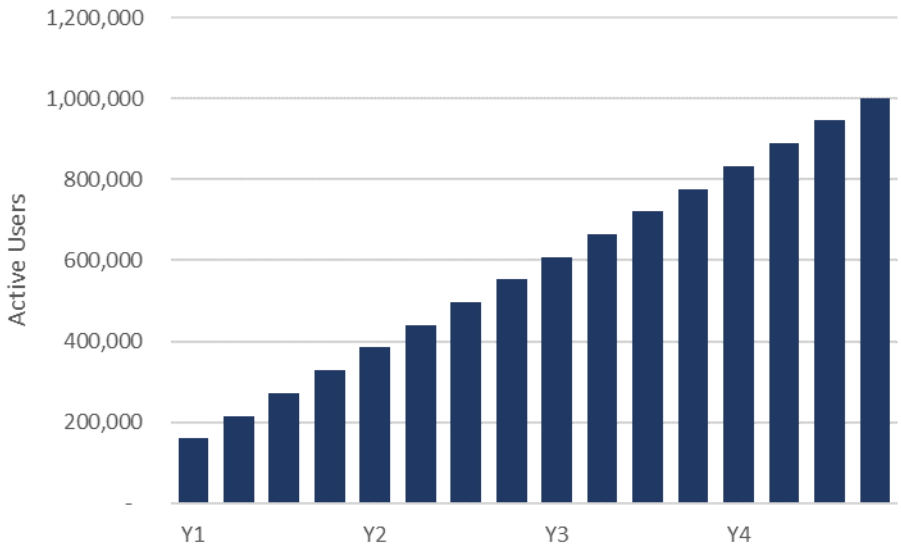
A financial model has been created to explore each of these options, based on cost data submitted by the mHealth Tanzania-PPP, Cardno, CABI, and GSMA.

7.2 The financial model

The model is based on operating cost structure and cost data provided by Cardno, supplemented by data gathered through interviews. These cost data include a quantification of in-kind contributions made by MNOs (donating SMS and USSD sessions) and partner NGOs (mainly time).

Key to the model is an estimated profile of user numbers, which is the basis of calculating revenues (from indirect benefits) and variable costs. The profile of active users in Figure 9 suggests numbers are continuing to rise, given roughly constant rates of new subscriptions, and relatively low rates of opt-outs. This is likely to be the case for at least five years, at which time early users will start to leave the system as their children reach five years of age. It is estimated that there were over 100,000 active users on the system at the beginning of the period for which reliable data are available, which were used to calculate the trends in Figure 9 (described in Section 6.2). The financial analysis is based on a four-year period, during which the number of active users can be expected to continue to rise, as illustrated in Figure 11.[16]

Figure 11: Estimated user numbers profile for four-year period



Source: Authors

Cash flow is calculated from estimates of revenues and variable costs, which depend on the customer numbers profile, as well as fixed costs. Details of cost components and estimates are presented in Annex E.

Cash flow (operating profit) = revenue – cost of sales – fixed costs

[16] Given the concerns over the quality of the early data, the number of active users as at November 2016 has been rounded down from 130,000 to 100,000.

Revenue:

- Indirect benefits – increase in ARPU.

Cost of sales:

- Cost of SMS – nominal value to MNO of text messages sent to customers (disaggregated by MNO).
- Cost of USSD sessions.

Fixed costs:

- Administration expenses (mHealth Tanzania-PPP) – project management, staff costs, platform, travel.
- Government institutions – in-kind staff costs.
- NGO partners – in-kind staff costs.
- Product development – content curation.

The analysis considers the viability of the service from various perspectives, including the MNOs under the current arrangements, but also possible commercial scenarios. Therefore, it considers investment costs incurred in developing the product for roll-out in a specific country. The following investment costs have been included in the model (see Annex E):

- global content development;
- localisation of content – e.g. developing appropriate messages, seeking necessary approvals; and
- support service provided by the mNutrition programme – formative evaluation, UX consultants.

Note that no direct grant payments were made to the mHealth Tanzania-PPP under the mNutrition programme.

7.3 Public good model

Under the current arrangement, the mHealth Tanzania-PPP is funded by public money (from international donors), and the service is enabled by the charitable donation of SMS messages by the MNOs. Given the government's position that the service cannot be charged for, and the increasing role of the MoHCDGEC in the delivery of the service, it is not likely that any shift towards a more commercial business model will take place in the foreseeable future.

The costs of developing the Wazazi Nipendeni service have been covered by CDC, as part of its public health programmes. The costs of developing the additional nutrition content have been covered by the mNutrition programme. The service is funded and regarded as providing a public good, which it undeniably is. However, the quantitative study has shown that the MNOs are reaping tangible, if indirect, financial benefit from the service. This section considers the value of this benefit to partner MNOs under the current arrangement.

Financial reporting by the mHealth Tanzania-PPP quantifies the financial contribution made to Wazazi Nipendeni by each of the supporting MNOs. It does this by estimating the number of SMS messages donated by each MNO and then multiplying that by the consumer retail price of SMS messages. In the absence of any payment to Wazazi Nipendeni for the content, the cost of

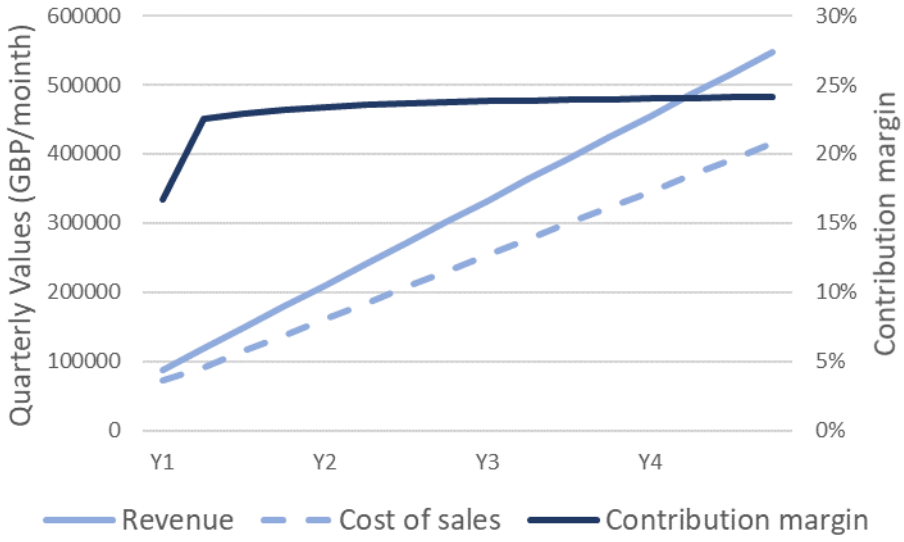
messages is the only variable cost, but it varies between MNOs according to the different SMS retail prices.

The quantitative research found that ARPU was TZS 510 higher among people who used Wazazi Nipendeni (compared with those who did not use the service). Given an ARPU of TZS 5,300 per month (£1.90 /month) among the control sample, this indicates that the VAS stimulates a 10% increase in ARPU. This is supported by the finding from the qualitative research that women became more comfortable and confident in using their phone when they received messages from Wazazi Nipendeni, implying that they then used their phone more, using more airtime.

Given the user growth profile in Figure 11, the contribution margin flattens out at 24% (see Figure 12). The cost of SMS messages is directly proportional to the number of active users. However, the cost of USSD sessions relates to the number of new users, which is assumed to be constant despite monthly fluctuations. At high user numbers, this cost component becomes a much smaller proportion of variable costs, dropping from 9% of variable costs in Year 1 quarter 1 to 1% of variable costs in Year 4 quarter 4. This explains why the contribution margin is lower at lower user numbers.

Note that the variable costs in Figure 12 are based on the aggregated costs across all four MNOs, each of which has been allocated different charge rates for SMS messages according to their retail prices (at baseline). Table 3 shows the sensitivity of contribution margin to SMS price (at high user numbers).

Figure 12: Contribution margin



Source: Authors

Table 3: Contribution margin for each operator (asymptotic)

MNO partner	SMS price (TZS/SMS)[17]	Contribution margin (Year 4)
Vodacom	57.6	29%
Airtel	69	15%
Tigo	79	3%
Halotel	33[18]	61%

Source: Authors' own

The price attributed to sending SMS messages is clearly highly influential in determining how attractive their contribution to Wazazi Nipendeni appears to operators. So what is the cost to an operator of sending an SMS? In a study on the impact of consumer consumption of network services (voice, SMS, and data) on network profitability, Blackburn *et al*., (2013) highlight a trend towards flat-rate pricing (as opposed to pay as you go). They point out that one feature that makes this attractive to operators is that the cost of delivery is a small fraction of the retail price. Keshav (2009) concluded that the cost of sending an SMS message was likely to be less than $0.003/SMS, or 2% of the per unit price charged to pay as you go customers (in the USA). Lack of clarity on the true cost of sending SMS messages continues to plague development cost modelling. For example, in a study of an mHealth intervention in Tanzania, Mangaone *et al*., (2016) modelled scenarios using standard SMS charge rates ($0.03/SMS), along with reduced rates ($0.02/SMS and $0.01/SMS), representing negotiated bulk purchasing agreements.

The analysis up to this point has been based on the retail prices given in Table 3, which can be interpreted as representing an opportunity cost to the MNO. However, given that MNOs are sending out messages to thousands of users, it could be argued that a bulk SMS price would be more realistic. A price of TZS 25/SMS, for example, would give a contribution margin of 70%. If, on the other hand, there is no real cost to the MNO of sending SMS messages, then the contribution margin tends towards 100%.

The contribution margin is a measure of how much a product contributes to fixed costs and thereby to profit (once fixed costs are covered). However, it takes no account of any investment made in developing a product, so it cannot be used as a predictive measure of the likely financial viability of developing a product; IRR is widely used for this purpose.

The model indicates that over a four-year period, mobile operators donate texts and USSD sessions totalling a nominal value of £3.9 million. However, over the same time period, the indirect benefit of ARPU sums to a total of £5.1 million, which represents a real financial gain.

The other indirect benefit often credited to VAS is a reduction in churn (Tricarico, 2016). However, the quantitative research did not find any evidence that people using the Wazazi Nipendeni service had owned their SIMs for longer. Prepaid markets tend to have high churn rates because consumers are not 'tied in' to contracts; the Tanzanian market is predominantly prepaid so high churn rates might be expected. However, in rural or underserved markets where signal coverage is poor, consumers often find themselves effectively tied in to a single operator by virtue of being able to access only one network in their geographical location. Therefore, churn tends to be lower in rural areas. The quantitative study was carried out in Iringa, which is a largely rural district, so it is not surprising to find low rates of churn, making it difficult to measure any differences in churn.

[17] From mHealth Tanzania-PPP financial report 2017.
[18] Halotel was not a partner in 2017 so was not included in the financial report. This is the price given on the website (accessed September 2019).

7.4 Commercial content provider

The previous section highlighted the financial benefits to MNOs of offering the Wazazi Nipendeni service. This opens up possibilities for the content provider to generate revenue through some kind of revenue share agreement with MNOs, which in turn opens up possibilities for spinning off the content provider as a commercially viable venture. This section considers the financial viability of such a venture as a hypothetical case, based on cost data from the mHealth Tanzania-PPP. It is intended to represent the opportunity for replicating an mHealth agency delivering a service similar to Wazazi Nipendeni in another country.

The model is based on the following assumptions regarding capital costs:

- Nutrition content developed under the GSMA mNutrition programme is publicly available and open source, so the 'raw' content can be accessed and adapted at no cost.
- There is a real cost associated with localising content. This includes framing the content in messages that are relevant and readily understandable by users, as well as translating content into local languages. In the case of Wazazi Nipendeni, messages are all in written format for disseminating as SMS messages, which avoids the considerable expense of making voice recordings that are needed for outbound dialling and other voice-based systems. Securing government approval of messages is a major cost. Health services tend to be highly regulated, and the experience of Wazazi Nipendeni is that the health ministry was diligent in ensuring that messages were consistent with Government of Tanzania health policies. A good deal of time was spent negotiating the balance between making messages factually accurate yet at the same time informal and easy to understand.
- An agency would need to invest in product development, as was the case with Wazazi Nipendeni, which benefited from UX research and formative evaluation throughout the duration of the mNutrition programme (both of which were funded through the GSMA mNutrition programme).

These costs sum to an investment of £312,500 (see Annex E).

The following assumptions have been applied regarding operating costs:

- the fixed operating costs associated with running the mHealth Tanzania-PPP will not change;
- the content will need to be continually reviewed and revised in order to keep it consistent with developments in government health policy and practice; and
- the agency would need to bulk purchase SMS messages from each client operator. A price of TZS 25/SMS has been assumed.[19]

It is assumed that the hypothetical agency would start from scratch, with no pre-existing users, so the model is based on the profile of active users presented in Figure 9.

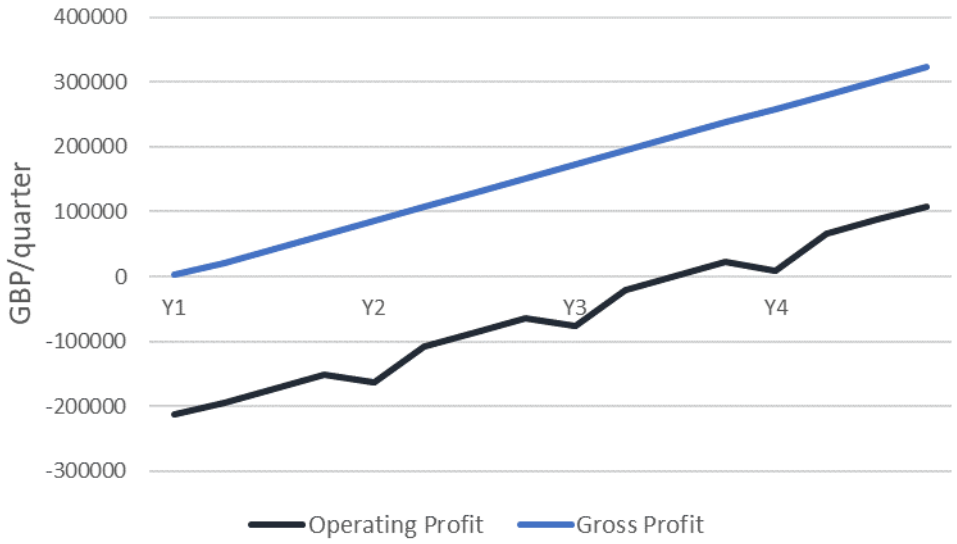
Note that no account has been taken of the in-kind contributions made by government agencies and partner NGOs, both of whom are critical to the success of a service. It can be argued that any government has a vested interest in setting up a service that has a material benefit for health outcomes, and so should forego any potential claims on the cost of the time they invest in mediating on behalf of the service provider. Similarly, it can be argued that the cost of the time

[19] https://sendsms.co.tz/pricing/

invested by partner NGOs, including marketing and registering users, is outweighed by the benefits that the service adds to their field programmes.

At 100% revenue share with MNOs (i.e. all TZS 510/user/month in increased ARPU goes to the content provider), Figure 13 suggests the service would break even at the beginning of year 3. However, the rate of return on investment over a four-year time horizon would be negative. Given the assumed trajectory of growth in user numbers, much greater revenues are generated if the timescales can be extended. Therefore, at 100% revenue share, the service could generate a positive IRR of 4% over a six-year period. However, rate of return is highly sensitive to revenue share: at 90% revenue share (i.e. the MNO retains only 10% of the increase in ARPU), the IRR turns negative.

Figure 13: Profits – commercial content provider



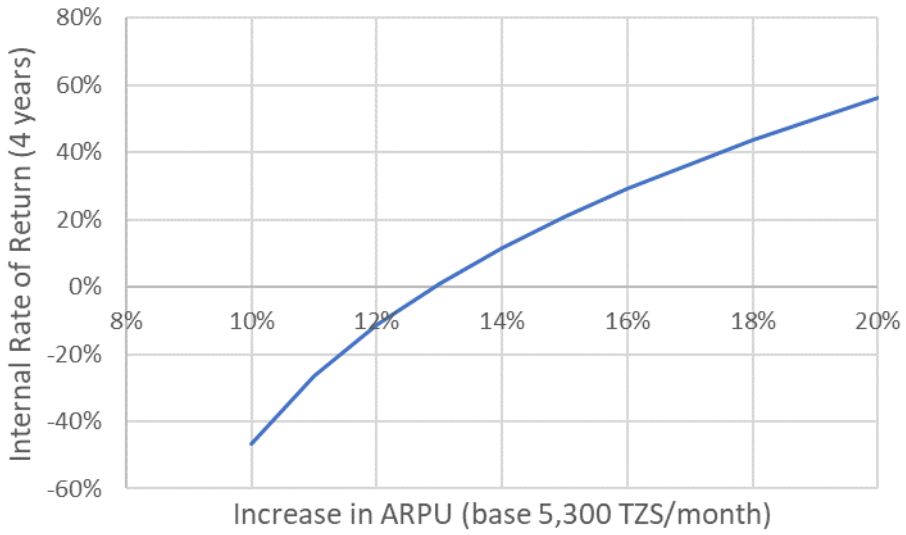
Source: Authors

Projecting the user growth profile in Figure 9 over a further two years would result in a total of 1.3 million active users. The population of Tanzania is 54.2 million (National Bureau of Statistics (NBS) 2019) and the average household size is 4.9 (MoHCDGEC, 2016), so the number of households across the country is around 11.1 million. 16.2% of the population is under five years of age (NBS, 2013), equating to 8.8 million children under five. If households with children under five had an average of two children both aged under five, then the total number of households with at least one child under five would be 4.4 million (40% of all households). This rough calculation suggests that a user target of 1.2 million Wazazi Nipendeni users may be ambitious but is not impossible.

As revenue is generated solely from increases in ARPU, the financial viability of such a VAS is highly sensitive to that increase. Up to this point, the analysis has been based on the TZS 510/month increase in ARPU found by the quantitative study (on a baseline level of ARPU of TZS 5,300 among the control sample). This is based on the effect of the random offer of access to the service in the quantitative study (i.e. comparing ARPU between the treatment and control samples). The study found that 66% of the treatment sample and 27% of the control sample reported having received nutrition messages by SMS (in the last two years). The study points out that this method of calculation was likely to underestimate effects, but the authors were unable to calculate more specific effects with any reliability because of inconsistencies in the self-reported access to the Wazazi Nipendeni messages. They concluded that this was because respondents may not have been able to correctly identify the source of nutrition text messages received.

Figure 14 shows how sensitive the financial viability of a service is to this effect size, and it shows that if the effect size was 15%, then a service could be financially attractive over a four-year period. Based on the proportions of both samples that reported receiving nutrition message by SMS, the effect size could be double (20%), in which case the return on investment would be highly attractive.

Figure 14: Sensitivity of IRR to increase in ARPU (content provider)

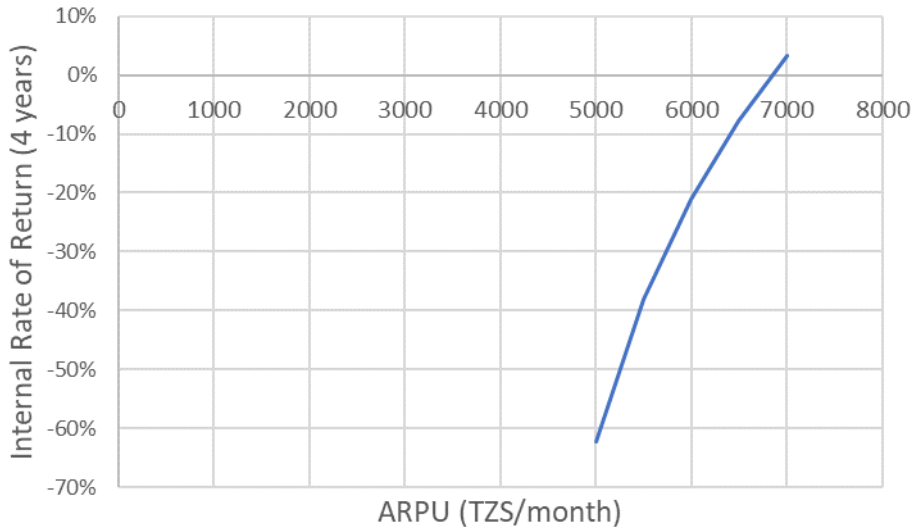


Source: Authors

The large number of active users means that financial indicators are highly sensitive to changes in ARPU. The ARPU found among the control sample was TZS 5,300, which is consistent with published data. Vodacom Tanzania quotes ARPU figures of just over TZS 6,000 (for the year ended March 2019 (Vodacom, 2019)), and Airtel has published consolidated data covering five East African countries (Airtel Africa, 2019), quoting an ARPU of $2.4 (December 2018, TZS 5,500).[20] The quantitative study was conducted in Iringa, a rural district, so measured ARPU levels would be expected to be below that national average. Figure 15 shows that, if all other assumptions are held constant, a service would need to reach a user base with an ARPU over TZS 7,000/month in order to generate a positive IRR over a four-year period. This is unlikely, given that these reports, as well as industry analysis (BMI Research, 2016), confirm a current trend of declining ARPU. This figure is based on generating revenue from a 10% increase in ARPU.

[20] Based on an exchange rate of TZS 2,300/$1.

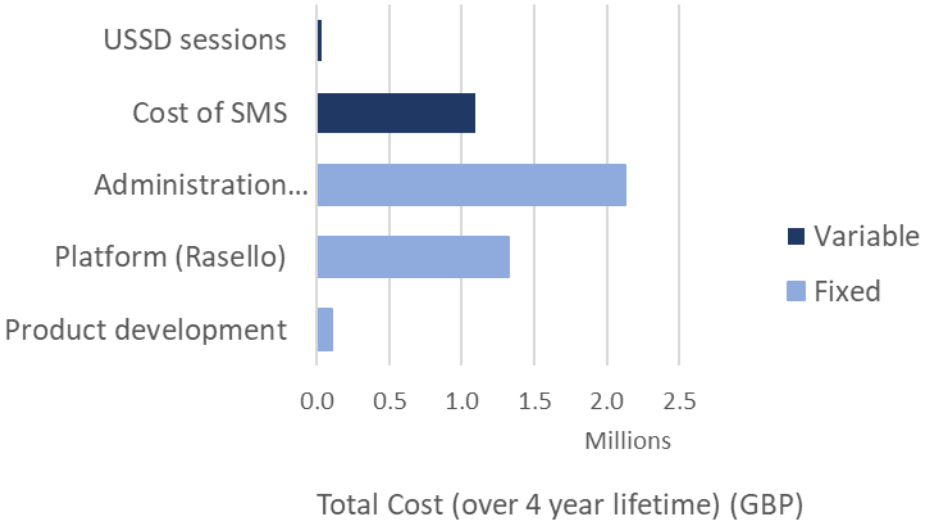
Figure 15: Sensitivity of IRR to ARPU



Source: Authors

The breakdown of operating costs over a four-year period shows how the fixed costs associated with running the mHealth Tanzania-PPP and running the technology platform are dominant (Figure 16). Analysis shows that central expenses would need to be reduced by 40% (from the levels estimated in Annex E) in order to produce a positive IRR of 4% over a four-year time period (at 100% revenue share). Again, even at 90% revenue share the IRR turns negative.

Figure 16: Operating costs (four-year period)



Source: Authors

Consider a scenario in which an independent mHealth VAS provider can develop and deliver an information dissemination service under the following assumptions:

- a 20% reduction in fixed operating costs (staff time and platform costs);
- a nationwide ARPU of TZS 6,000 /month;
- a 15% increase in ARPU when consumers use the mHealth VAS;

- a 50% revenue share with MNOs; and
- an SMS price of TZS 25.

These positive assumptions indicate that such as service could generate a positive IRR of 6% but only over a six-year period.

7.5 In-house MNO service

The quantitative study has shown that consumers using Wazazi Nipendeni spend more money on airtime, estimated to be equivalent to a 10% increase in ARPU. This raises the possibility that an MNO could justify creating an mHealth VAS on the basis of this increased revenue. This section considers a hypothetical business case scenario in which an MNO in another country sets up an mHealth service in-house. The key differences from the commercial content provider scenario considered above is that the MNO would retain all of the additional revenue generated, and there would be no real costs associated with the SMS messages sent.

The model is based on the following assumptions regarding capital costs:

- Nutrition content developed under the GSMA mNutrition programme is publicly available and open source, so the 'raw' content can be accessed and adapted at no cost.
- There is a real cost associated with localising content. This includes framing the content in messages that are relevant and readily understandable by users, as well as translating content into local languages and securing government approval of messages.
- The MNO would need to invest in product development, as was the case with Wazazi Nipendeni, which benefited from UX research and formative evaluation throughout the duration of the mNutrition programme.

These costs sum to an investment of £312,500 (see Annex E).

The following assumptions have been applied regarding operating costs:

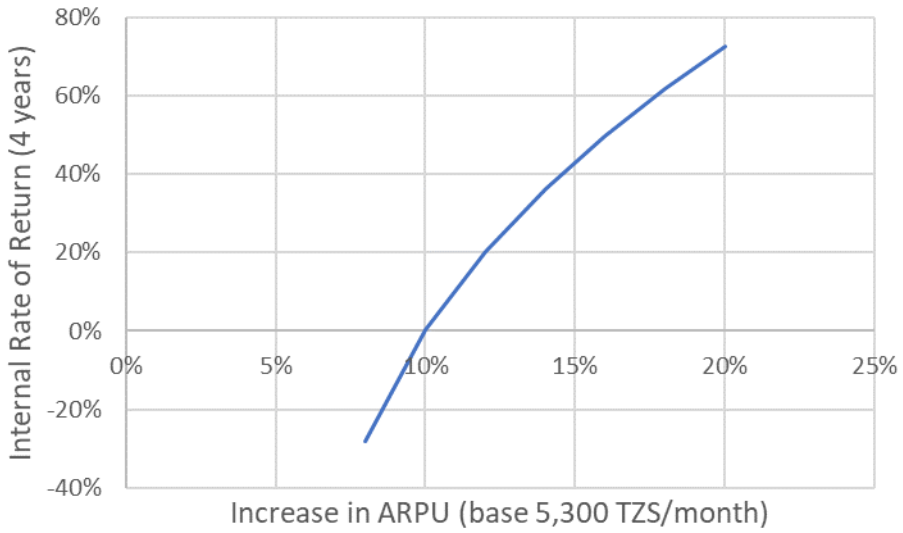
- The fixed operating costs associated with running the mHealth VAS in-house would be the same as for Wazazi Nipendeni.
- The content will need to be continually reviewed and revised in order to keep it consistent with developments in government health policy and practice.
- The MNO would be able assign the real cost of sending SMS messages and USSD sessions (both have been zero-rated in the analysis).
- No account has been taken of the in-kind contributions made by government agencies and partner NGOs, both of whom would be critical to the success of such a service.

It is assumed that the hypothetical MNO-based service would start from scratch, with no pre-existing users, so the model is based on the profile of active users presented in Figure 9.

If SMS messages and USSD sessions are zero-rated then the service would break even in year 3, although it would not generate enough cash to provide a positive return on investment over a four-year period. Assuming the same trajectory of increasing users' numbers in Figure 11, the large number of users (rising to 1.1 million) would generate enough revenue to provide a 19% IRR in a five-year period.

As revenue is generated solely from increases in ARPU, the financial viability of such a VAS is highly sensitive to that increase. Up to this point, the analysis has been based on a TZS 510/month increase in ARPU found by the quantitative study (on a baseline level of ARPU of TZS 5,300 among the control sample), i.e. an effect size of approximately 10%. As described above, this is likely to be an underestimate and the real effect size could be double (a 20% increase in ARPU). Figure 17 shows how sensitive the financial viability of a service is to this effect size, and that even if the effect size was marginally higher than 10%, then a service could be financially viable in a four-year period. Based on the proportions of both samples that reported receiving nutrition messages by SMS, the effect size could be double (20%), in which case the return on investment would be highly attractive.

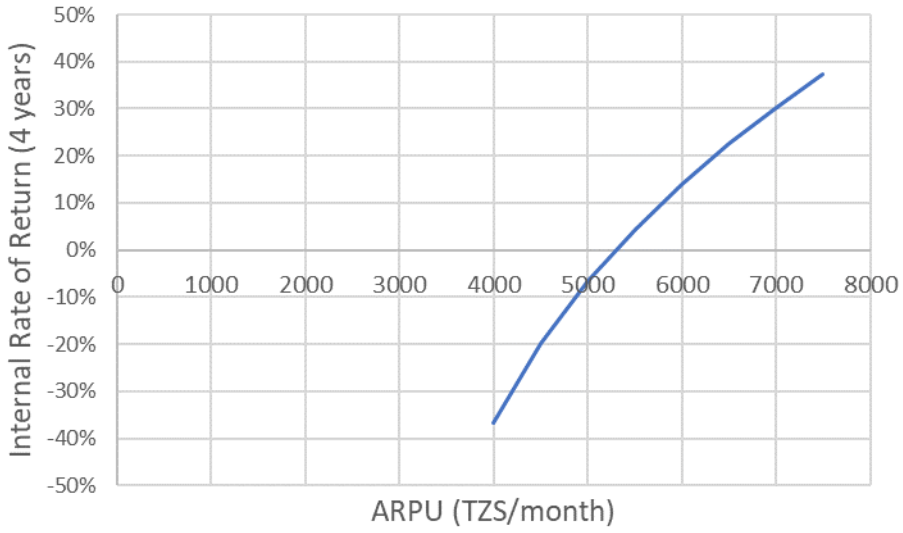
Figure 17: Sensitivity of IRR to increase in ARPU (in-house MNO)



Source: Authors

The large number of active users means that financial indicators are highly sensitive to changes in ARPU. The ARPU found among the control sample was TZS 5,300, which is consistent with published data as described above. Figure 18 shows that a service could generate a positive IRR over a four-year period if offered to a user base with an ARPU of around TZS 6,000, which appears to correspond more or less to the Tanzanian market average. The study was conducted in Iringa, a rural district, so measured ARPU levels would be expected to be below that national average. This figure is based on generating revenue from a 10% increase in ARPU.

Figure 18: Sensitivity of IRR to ARPU (10% effect size)



Source: Authors

Consider a scenario in which an in-house mHealth VAS can be developed and delivered under the following assumptions:

- a 20% reduction in fixed operating costs (staff time and platform costs); an MNO would be quite capable of setting up their own platform, which could reduce real costs still further;
- a nationwide ARPU of TZS 6,000 /month; and
- a 15% increase in ARPU when consumers use the mHealth VAS.

These positive assumptions indicate that such a service would be financially attractive, providing an IRR of approximately 70% over a four-year period.

There are non-financial constraints that an MNO would face if implementing an in-house mHealth VAS as described in this section. These relate to relations with government and NGO partners. In the case of Wazazi Nipendeni, TFNC was instrumental in securing approval of the messages. Any government body would need to be seen to be scrupulous in its dealings with a private sector organisation, and would be keen to avoid accusations of partisanship. While a government agency might be keen to support an enterprise that is clearly for the public good, it may be more measured in its support for a private sector venture. This depends on the country context; in countries with strong policies on ICT and private sector growth, government agencies may be keen to support this kind of venture.

8 Changes in the mobile ecosystem

8.1 The political economy

The telecommunications market in Tanzania has been subject to continued political influence over the duration of the evaluation study. The Electronics and Postal Communications Act was introduced in 2010 and required telecommunications companies to offer at least 25% of their shares to the public by floating on the Dar es Salam stock exchange, and to do so within three years (The Electronics and Postal Communications Act, 2010). This move was resisted by operators and the provision was not enforced at first. However, when a new president was elected (at the end of 2015), the bill was amended in 2016, giving companies a further three years to make shares available. Vodacom was the first of the operators to comply, listing on the stock exchange in August 2017.[21] At the beginning of 2019, Vodacom was still the only company to have complied.[22]

Tigo in Tanzania is the trading name of MIC Tanzania plc.[23] However, ownership of shares in MIC Tanzania has been in dispute. Two companies owned by a single businessman (Golden Globe International Services Ltd and Quality Group Ltd.) alleged that they bought shares in 2014 entitling them to a 99% stake in MIC Tanzania, although the complex dispute traces its roots back to 2002.[24] Only in July 2018 did the courts rule that MIC Tanzania was the legal owner of Tigo Tanzania.[24] Up until that point, the dispute had meant that Tigo was not been able to make provision for any public offering of shares.

Any plans for Airtel to comply with the share offer obligation have also been delayed by a dispute over ownership. Celtel acquired a stake in the Tanzania Telecommunications Company Limited (TTCL, the incumbent operator) in 2001, and the Government remained the majority owner. The successful mobile operator, branded Celtel, was subsequently set up as an independent mobile operator, wholly owned by TTCL. In 2005, the two were legally separated but Celtel retained a 35% stake in TTCL while TTCL was left with a 40% holding in Celtel.[25] Around the same time (2005), Celtel was purchased by Zain. Zain was then purchased by Bharti Airtel in 2010, and has since been trading as Airtel. In 2017, the Government made a claim on the ownership of Airtel, alleging irregularities in the original privatisation process. This argument is not without merit, as one of the problems characterising privatisation processes at this time was a lack of data (Christen *et al*., 2005). The matter has only recently been resolved by Bharti agreeing to make a number of ongoing payments to the Government, and giving the Government further shares to bring its shareholding up from 40% to 49%, leaving Bharti still in control.[26]

Another indication of the extent of renewed political interest in the telecommunications sector was the replacement of the head of the telecoms regulator by the new president, on the grounds that TCRA had failed to extract correct tax revenues.[27]

Mobile operators have also fallen foul of the judiciary in Tanzania, in line with the president's anti-corruption drive and the targeting of multinational companies in Tanzania's mining and telecoms

[21] https://oxfordbusinessgroup.com/news/first-tanzania%E2%80%99s-telecoms-operators-goes-public
[22] https://theexchange.africa/why-most-tanzanian-telcos-have-failed-to-float-their-shares/
[23] www.millicom.com/media/3665/millicom-20f-filed-version.pdf
[24] www.thecitizen.co.tz/news/Tigo-IPO-now-imminent/1840340-4683568-h8rg56/index.html
[25] www.telegeography.com/products/commsupdate/articles/2005/08/22/celtel-and-ttcl-part-company/
[26] www.thecitizen.co.tz/news/1840340-5151278-8r654i/index.html
[27] www.thecitizen.co.tz/news/President-Magufuli-confirms-Mr-Kilaba-as-the-new-TCRA-boss/1840340-3410484-hx2ojy/index.html

sectors to address tax evasion. In 2018, the CEOs of Halotel and Zantel were charged with fraud.[28] More recently, in 2019, following the arrest of its CEO, Vodacom Tanzania pleaded guilty to the charge of intending to avoid paying taxes.[29] In April 2019 it made a $2.3 million payment to the Government.

8.2 Developments in the market

According to the latest figures published by the regulator, the total number of mobile subscriptions has risen from to 40 million in March 2017 to 44 million in December 2018. The population has also increased, from 53.0 million in 2016 to 58.0 million in 2019[30] (representing a growth rate of 3.0% per year). The mobile market continues to mature, as the penetration rate increased from 78% in 2017 to 81% in 2018 (TCRA, 2019a). TCRA figures show erratic but continued growth:

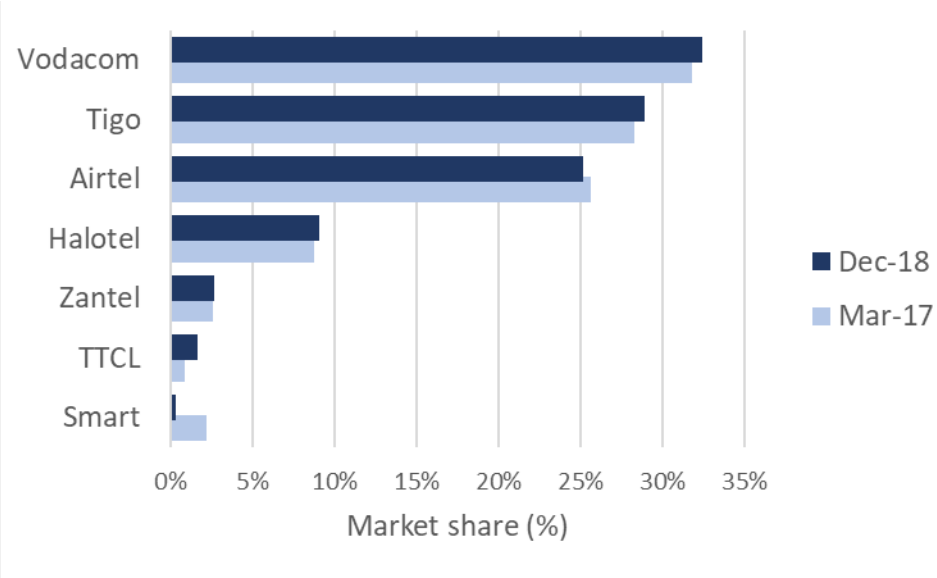
- January 2015 to January 2016 – 22.4% (numbers increased by 7.3 million).
- January 2016 to January 2017 – 0.3% (numbers increased by 0.1 million).
- January 2017 to January 2018 – 0.4% (numbers increased by 0.2 million).
- January 2018 to January 2019 – 9.7% (numbers increased by 3.9 million).

Mergers have also changed the dynamics of the market. At the time of the baseline study, Zantel was one of the MNOs that had signed up to support Wazazi Nipendeni. However, Tigo had bought 85% of shares in Zantel in 2015,[31] leaving the remaining 15% owned by the Government of Zanzibar. Zantel continued to trade under its own brand until recently. At the beginning of 2019, Tigo (owned by Millicom) initiated proceedings to acquire this remaining 15% by seeking regulatory approval.[32]

Vodacom continues to have the largest market share, and has increased this share from 31.7% (March 2017) to 32.4% (December 2018) – see Figure 19. The market share of the combined Tigo/ Zantel group rose to 29.4% (December 2018), substantially narrowing the gap between the second player and the market leader.

[28] https://uk.reuters.com/article/us-tanzania-telecoms/tanzania-charges-telecoms-executives-with-fraud-in-tax-evasion-crackdown-idUKKCN1J22PD
[29] www.reuters.com/article/tanzania-vodacom-tanzania/update-2-vodacom-tanzania-pleads-guilty-settles-charges-against-ceo-employees-idUSL8N21T48S
[30] www.worldometers.info/world-population/tanzania-population/
[31] www.thecitizen.co.tz/news/Tigo-finally-acquires-Zantel/1840340-2742156-9lywaf/index.html
[32] www.itwebafrica.com/tanzania/245356-tanzania-millicom-targets-full-ownership-of-zantel

Figure 19: Market share of voice subscribers (from TCRA data)

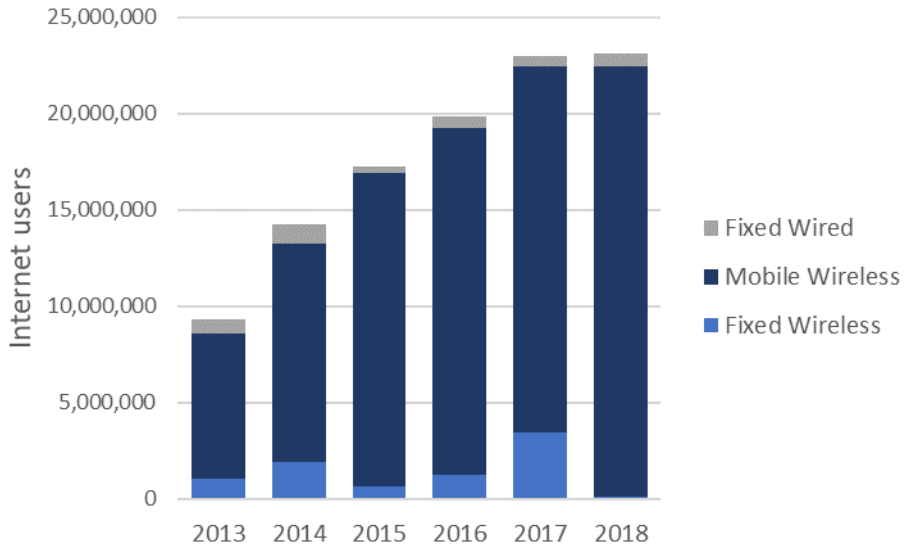


Source: Authors

It is estimated that 45% of the population of Tanzania is under the age of 15.[33] If they are considered to be economically inactive and highly unlikely to own a mobile phone, then the data more accurately represents a penetration rate of 147%, meaning that many adults own more than one SIM. This tends to reflect a mature market, but also hides uncompetitive market conditions, notably restricted network coverage in certain areas and off-net tariff premiums (i.e. it costs more to call someone on a different network).

Mobile internet subscribers have also grown over the period, from 17.3 million in 2015 to 23.1 million in 2018 (Figure 20, TCRA, 2019b). Expressed as a share of mobile subscribers, internet use has increased from 43% of wireless subscribers (both mobile and fixed) in 2015 to 52% in 2018.

Figure 20: Growth of internet subscribers (from TCRA data)



Source: Authors

[33] www.demographicdividend.org/country_highlights/tanzania/

There is an appetite among mobile operators to increase access to the internet and data use. For example, in June 2018 TCRA issued broadband licences to Vodacom Tanzania and Azam Telecom, with an obligation to achieve population coverage of 60% by 2021, increasing to 90% by 2025.[34]

8.3 Trends in mHealth Innovations

8.3.1 Technology and mobile business models

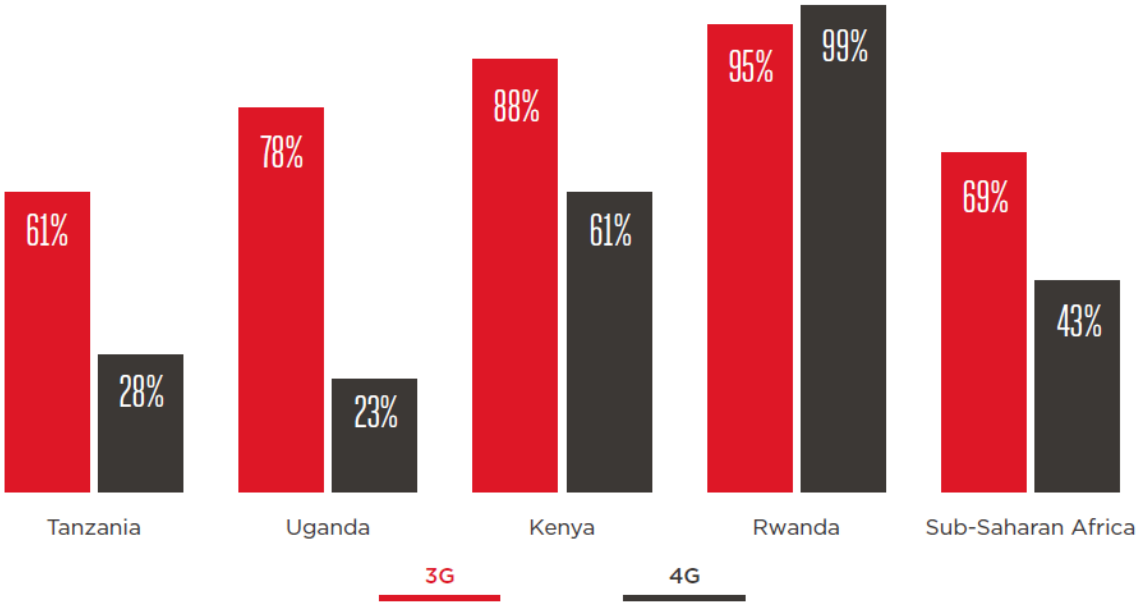
The majority of mobile internet connections are 2G, and Tanzania's broadband coverage lags behind its neighbours (see Figure 21). GSMA predicts that mobile data consumption across sub-Saharan Africa will multiply sevenfold by 2024 (from 1.1 to 8.5 GB/subscriber/month) (GSMA, 2019), and this is likely to be driven by 3G technology. Multiple features are driving data usage (see Annex F for further detail):

- Over the top (OTT) services continues to grow. In 2017, 20% of adults in Tanzania used social networking sites such as Facebook and Twitter (Pew Research Center 2018). Use has grown by one-third over the three years from 2014 to 2017.
- Increased revenue from data services can more than make up for any decline in voice revenue from OTT services (Esselaar and Stork, 2018).
- Entertainment services. TVs are becoming more widespread and the affluent are spending more time watching TV and video on mobile devices.
- Smartphone sales are on the rise. Smartphone ownership stood at around 13% of adults in 2017, well below the median for sub-Saharan Africa (33%) (Pew Research Center, 2018). GSMA estimates that the number of handsets will more than double from 2018 to 2025.

All this suggests that mobile data use is set to grow.

[34] www.telegeography.com/products/commsupdate/articles/2018/06/26/tanzania-allocates-700mhz-spectrum-to-vodacom-azam-telecom/

Figure 21: 3G and 4G coverage as % of population (2018)



Source: Okeleke, (2019)

Perhaps the most transformational technology that has blossomed since the baseline report is mobile money. In 2017, 60% of the population had a mobile money account (Okeleke, 2019), and TCRA figures show a 40% increase in accounts over a three-year period from 2016 to 2019. M-Pesa (Vodacom) is the market leader in Tanzania, at 40% market share, and Tigo Pesa is second, at 32%. Okeleke (2019) estimates that the value of transactions processed through mobile money services in 2017 was $22 billion, equivalent to almost half of the country's GDP.

8.4 mHealth innovations

The Health Data Collaborative[35] has done some interesting work on classifying digital health interventions, led by the Digital Health and Interoperability Working Group. It proposes that tools can be divided into the following high-level categories[36]:

- interventions for clients (e.g. client communication, health tracking, information services, financial transactions);
- interventions for healthcare providers (e.g. client registration, health records, decision support, telemedicine, information management, medication management);
- interventions for resource/ health system managers (e.g. human resources, supply chains, civil registrations, health financing, asset and facility management); and
- interventions for data services (e.g. data collection, coding, mapping, and exchange).

[35] www.healthdatacollaborative.org/
[36] https://docs.google.com/spreadsheets/d/1GEdfI8AQ_wC_SKAm9DhFlNMEnLKlKIcVC46lEws-UIs/edit#gid=2135971936

Wazazi Nipendeni assists pregnant women and mothers by providing them with information on how to look after themselves and their infant, so it falls into the broad category of client-facing tools. Within this category, the Health Data Collaborative give examples of services that fall into a range of sub-categories (see Annex G):

- Targeted client communication;
- Untargeted client communication;
- Client to client communication;
- Personal health tracking;
- On-demand information services provided to clients;
- Client financial transactions.

The classification makes a clear distinction between services providing unidirectional information dissemination to clients (targeted and untargeted) and client-initiated services (peer group, citizen reporting, and health information-seeking). Wazazi Nipendeni is an example of the first of these and is a 'push' service. The Viamo 3-2-1 service offered by Vodacom, on the other hand, is an example of a client-initiated service and is a 'pull' service, as it relies on the user to dial a short code to access information. In principle, a service could combine both aspects of communication as each has its advantages and drawbacks.

It is interesting to note that most of these examples are based on the SMS functionality of mobile phones. This is true even of the tools that deal with financial transactions, as they tend to use a platform that manages payments between healthcare providers, but the interaction with the client is done by SMS. This reliance on SMS tells us two things. Firstly, SMS is a good enough means of communicating with clients (i.e. constraints such as poor network coverage and illiteracy have not rendered the services unfeasible). Secondly, SMS is regarded as the most cost-effective medium for communicating with clients. This is closely linked to the first point, as voice-based services (such as outbound dialling and call centres) can overcome literacy and language constraints, but come at a much higher cost.

The classification was drafted in 2017, so more recent examples of mobile health projects exist. Many of these are beginning to exploit the potential of the internet, and smartphones in particular, of data acquisition and analysis, and of mobile money services (some examples are given in Annex G).

9 Discussion

9.1 Role of government

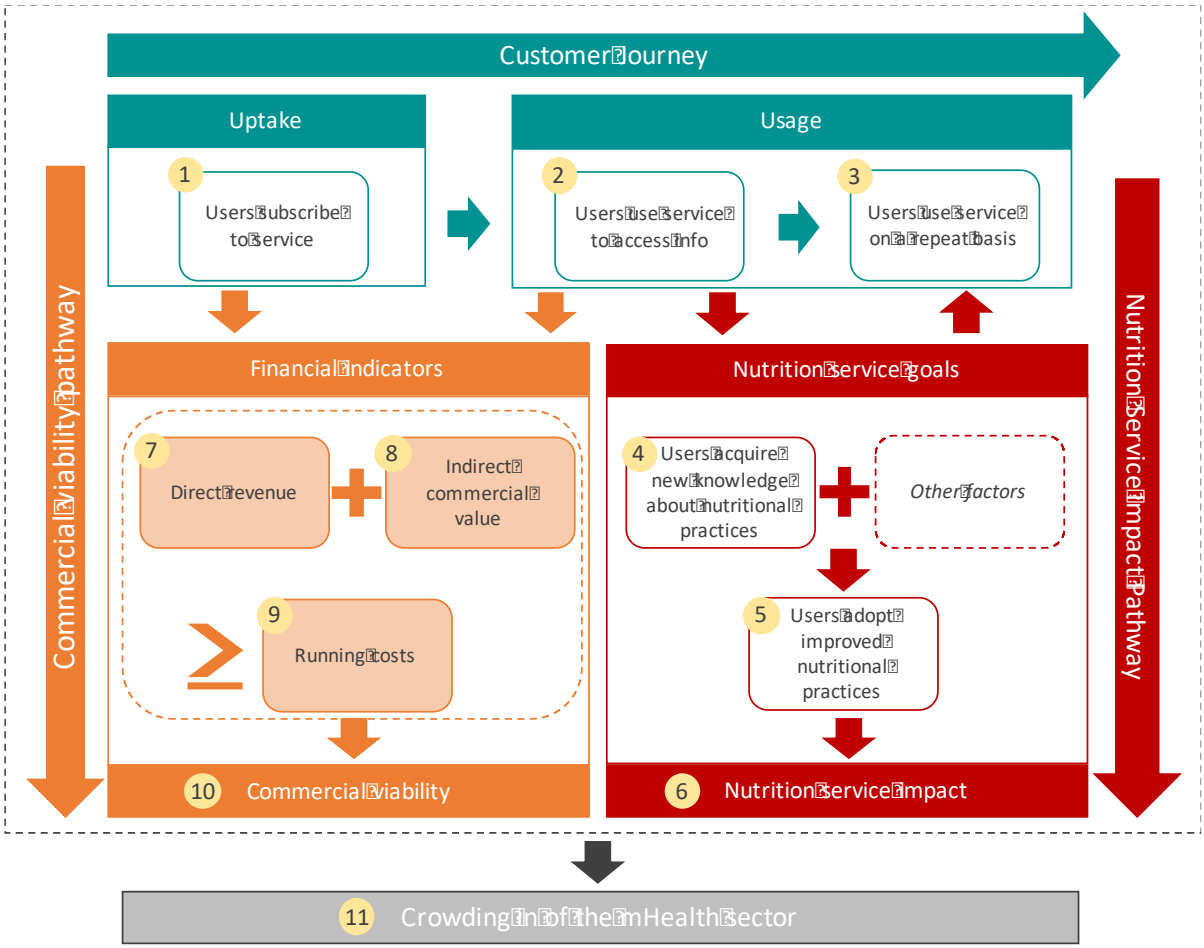
The case of Wazazi Nipendeni underlines the importance of working in partnership with government agencies. The role of MoHCDGEC and a range of departments within the ministry is evident in a variety of ways, for example:

- long-term commitment to the concept of using mobile phones to disseminate information to clients, starting with the PEPFAR Phones for Health programme in 2007;
- TFNC involvement in designing locally relevant and accessible messages;
- TFNC and its contacts was instrumental in securing approval for the content;
- government health workers played an active role in promoting the service and assisting women with registering;
- the Government was influential in brokering partnerships with field NGO health programmes;
- MoHCDGEC commissioned and paid for the new platform;
- making agreements with MoHCDGEC to support Wazazi Nipendeni has been of value to MNOs in the political economy of the industry;
- the Government is regarded as a trusted provider of information, so MoHCDGEC branding of messages has been important in building the Wazazi Nipendeni brand, which is important in a market plagued by spam.

9.2 Theory of change

Steps in the draft theory of change drawn up by GSMA (Figure 22) have been reviewed in the light of the findings from the study (see Table 4).

Figure 22: mHealth theory of change diagram



Notes. Draft theory of change diagram. © GSMA Intelligence (unpublished).

Table 4: Theory of change reviewed

Step	Description	Rating	Comment
1	Users subscribe to the service		The number of active users has been estimated at 550,000 as at the end of 2018. The cumulative number of people reached will be higher still. Users registered on the Wazazi Nipendeni service for free – they did not pay any subscription fee. No insights are available into willingness to pay for this kind of information dissemination service. Willingness to pay is likely to be low, given that users already have access to much of the information through health systems (messages acted as reminders to reinforce information provided by health workers, and to reinforce mothers' existing knowledge).
2	Users use service to access information		Among respondents who received messages, over 80% read the mNutrition content. Only 66% of households in the treatment group had received messages.
3	Users use service on a repeated basis		Of users who could identify messages as from Wazazi Nipendeni, only 19% received messages last month. Most did not know why, but 18% had lost SIM/ handset.
4	Users acquire new knowledge about nutritional practices		mNutrition increased knowledge of IYCF and nutrition for males, and increased the combined household-level measure of nutrition knowledge.
5	Users adopt improved nutritional practices		Over 80% self-reported implementing at least one tip. The study assessed IYCF practices and dietary diversity. Wazazi Nipendeni resulted in improved children's dietary diversity scores, the likelihood that children satisfied the minimum dietary diversity threshold, and the likelihood that they achieved a minimum acceptable diet. Women were more likely to meet the minimum dietary diversity threshold (despite no evidence of changes in household-level food consumption patterns).
6	Nutrition service impact		Wazazi Nipendeni had no impact on child nutrition as measured by anthropometry. The Wazazi Nipendeni service improved a range of nutritional outcomes, most notably multiple indicators associated with diets among young children.
7	Direct revenue		TFNC stipulated that the Wazazi Nipendeni service was to be provided free of charge to users.
8	Indirect commercial value		The Wazazi Nipendeni service increased ARPU by at least 10%, likely to be higher. Wazazi Nipendeni did not reduce churn (churn tends to be low and difficult to reduce in underserved rural areas).
9	>= running costs		The theory of change implies that running costs are incurred by the same entity that receives revenue. This is not the case with Wazazi Nipendeni, where MNOs receive increased revenue but the mHealth Tanzania-PPP incurs costs. At an SMS price of TZS 25, revenue would exceed costs at over 250,000 users.
10	Commercial viability		The theory of change implies that a service would be viable if revenue exceeds running costs, but this takes no account of return on investment. Wazazi Nipendeni can trace its roots back through donor-funded programmes to 2001. A scenario for setting up a hypothetical in-house MNO service indicates it could provide a positive IRR over four years, but this has not been proven. Setting up a hypothetical independent content provider (like the mHealth Tanzania-PPP) would be less attractive, providing a positive return over six years.
11	Crowding in of the mHealth sector		Having demonstrated the viability of the PPP, and the reach of mobile services, the mHealth Tanzania-PPP has entered into agreements with other field partners (for Wazazi Nipendeni), and has developed additional mobile services. It is too early to say whether this has increased demand (and funding) for mobile services, and it is too early to expect the private sector to move into the market.

Key:

	Step fully realised
	Step partially realised
	Step not realised
	Insufficient information

Source: Authors' own

The Theory of Change in Figure 22 reflects an emphasis on commercial sustainability that is consistent with the original Business Case,[37], which refers to the value of demonstrating sustainable business models in reducing risk for commercial investors. The role of donor funded business models in the mHealth sector at the time was well recognised; the initial GSMA scoping study presented three services, all of which were classified as having 'donor funded' business models (GSMA 2014).

The original mNutrition documentation emphasised the role of private sector investment in taking mobile services to scale. However, the experience of Wazazi Nipendeni shows that it is also possible for donor funded mHealth services to reach scale. In fact, Wazazi Nipendeni reached substantially more users than any of the other mHealth projects supported through the mNutrition programme (GSMA 2018). Although negotiations have yet to be concluded, evidence to date suggests that the donor funded business model can be effective in attracting further investment, albeit from donors rather than the private sector.

Although not explicit in Figure 22, one of the features of the mNutrition programme is the potential for mobile services to achieve positive outcomes ("Nutrition service impact" in Figure 22) among poor and disadvantaged groups. It has been pointed out that Wazazi Nipendeni is offered as a national service available through multiple networks and does not, therefore, have a particular poverty focus. There are, however, implications for the extreme poor arising from the different business models considered. Two hypothetical models are considered in Section 7 – a third party content provider and an in-house MNO driven model. An independent content provider would typically enter into agreements with organisations providing health services on the ground (a B2B model), whereas an MNO would offer a service directly to their customers (B2C model). Wazazi Nipendeni is an interesting hybrid, as the service is made available to MNO customers and at the same time the mHealth Tanzania-PPP has entered into agreements with agencies implementing health programmes on the ground.

Cost of sales is a key factor in any MNO driven model and must be balanced with any increase indirect benefits, especially if the service is to be freely available as in Tanzania. Literacy clearly presents a barrier to accessing SMS based services. Voice-based services (such as outbound dialling and call centres) can overcome literacy and language constraints but are prohibitively expensive.

Third party models have the flexibility to buy bulk SMSs from multiple MNOs. The partnership agreements that the mHealth Tanzania-PPP has forged with MNOs are a key feature of the service, meaning that it is accessible to customers on all of the major networks. This increases reach among the extreme poor who tend to live in underserved areas where signal coverage is poor and consumers have no choice of operator as they can access only one network in their geographical location. The agreements they have made with implementing agencies also increases reach among the extreme poor as field partners' programmes tend to focus on vulnerable communities in rural areas.

[37] http://iati.dfid.gov.uk/iati_documents/4139050.odt

An mhealth service provider will tend to have a focus on the health sector, whereas MNOs have a focus on upselling to maximise revenue from a customer segment. The lower spending power of the extreme poor makes it difficult for an MNO to justify investing in developing services targeted at this group. Emerging data based services will be instrumental in overcoming literacy barriers (e.g. using audio and video) but not in the foreseeable future, while data rich services emerging (e.g. integrating financial services) will exclude the extreme poor who do not have the digital literacy skills needed.

9.3 MNOs

The merged entity of Tigo and Zantel has a market share close to that of the market leader, Vodacom (see Figure 19). This threat to Vodacom's dominant position is likely to result in increased competition. As operators look for innovations and opportunities to attract and keep customers, they may well prioritise exploring commercial opportunities to capitalise on their support for Wazazi Nipendeni. Not only Wazazi Nipendeni, but the operators will also be keeping an eye on competing and alternative mobile health solutions to spot opportunities. The mHealth Tanzania-PPP and TFNC will need to liaise closely with supporting MNOs to ensure that they continue to be satisfied that Wazazi Nipendeni provides commercial benefits, and to engage in ways such that the service can be adapted to meet the changing priorities of MNOs.

9.4 Possible mechanisms for revenue generation

Despite the best efforts of GSMA to prompt innovative thinking on ways of generating revenue, the mHealth Tanzania-PPP model remains essentially unchanged, save for greater involvement of MoHCDGEC. The model may be forced to change if donor funding through CDC is not renewed when the current agreement expires in 2020. Stakeholders commonly mentioned the idea to charge field partners. Firstly, the mHealth Tanzania-PPP could charge for providing messages to clients registered by the partner; and, secondly, the mHealth Tanzania-PPP could charge for the time and effort spent developing new, bespoke content for the partner (on a consultancy basis). The trouble is that the first of these is a symbiotic relationship – the mHealth Tanzania-PPP provides messages while the field partner assists women to register in the field, so could partners then charge the mHealth Tanzania-PPP for each user registered?

Another possibility being pursued is getting private sector partners to sponsor messages as a means of advertising. TFNC has pointed out that it has guidelines on the types of goods that it would permit to be associated with Government-endorsed health messaging, e.g. food products would not be permitted.

The mHealth Tanzania-PPP has also looked at bringing on insurance partners, which is an interesting idea given the advent of new mHealth services using smartphone apps that use mobile money functionality. This opens up possibilities not only for sponsorship, but also for incorporating innovative payment features into the health messaging service (e.g. discounts on insurance premiums for Wazazi Nipendeni users).

9.5 Trends in mHealth services

Although mobile subscriber numbers continue to grow, growth in internet subscribers is much greater. The majority of mobile internet connections are 2G, and Tanzania's broadband coverage lags behind its neighbours. Smartphone ownership stood at around 13% of adults in 2017, well

below the median for sub-Saharan Africa (33%). This all suggests that mobile data use is set to grow and there is indeed an appetite among mobile operators to increase access to the internet and data use. Further investment may be forthcoming now that disputes involving the major MNOs have been resolved.

The mobile money industry has grown rapidly in Tanzania, and 60% of the population had an account in 2017. Recent mHealth services are beginning to exploit the potential of the internet, and smartphones in particular, of data acquisition and analysis, and of mobile money services. Integrating mobile money means that services can offer users the ability to pay subscriptions, make purchases, and access financial services such as credit and insurance. For example, Tigo partnered with a micro-insurance company, Milvik Tanzania, to offer the BimaMkononi mobile insurance service.[38] Customers can buy hospital insurance, accident insurance, and life insurance. Premiums can be paid using Tigo Pesa or by cash at a Tigo customer service centre. The service takes advantage of the mobile money platform, and provides an incentive for users to join the mobile money service.

9.6 Financial viability and scenarios

The commercial content provider scenario discussed in Section 7.4 is based on the mHealth Tanzania-PPP model but generating revenue through a revenue share agreement with MNOs (albeit indirect revenue). One of the dilemmas facing VAS developers, especially those operating in the public goods space, is whether to enter into an agreement with a single MNO, or to make their offering available across all networks. Using multiple networks potentially increases the reach of a VAS, but it instantly eliminates one of the indirect benefits of VAS – reduced churn. There is no incentive for a consumer to stick with a given operator if a service they like and want to use can also be accessed on other networks. For this reason, MNOs are generally only interested in entering into exclusive agreements. This means that the commercial content provider scenario considered in Section 7.4 may be difficult to broker in practice.

The alternative of an in-house MNO-based service may, therefore, be a more realistic option. The financial modelling also suggests it is easier to make a financial case for this model given that all of the increase in revenue would be retained by the MNO and the real cost to an operator of sending SMS messages is minimal. This is also closer to the majority of projects supported by the mNutrition programme, which were led by MNOs, although in most cases the MNO entered into a partnership with a VAS content provider (Viamo was the VAS provider in four projects), rather than setting up expertise in house (see GSMA, 2018). One of the potential drawbacks of this private sector-led approach is that a government may have reservations about lending its branding to a corporate product.

The scenarios proposed above have been prompted by the increase in ARPU demonstrated by the quantitative study. Reduced churn is a further indirect benefit commonly associated with VAS when provided by an MNO, yet the quantitative study found no evidence of reduced churn among Wazazi Nipendeni users. Prepaid markets tend to have high churn rates because consumers are not ‘tied in’ to contracts, and the Tanzanian market is predominantly prepaid. However, in rural or underserved markets, where signal coverage is poor, consumers often find themselves effectively tied in to a single operator by virtue of being able to access only one network in their geographical location. Therefore, churn tends to be lower in rural areas.

[38] www.tigo.co.tz/bima-mkononi-insurance

9.7 Looking back

Looking back on the development of the mHealth Tanzania-PPP and the Wazazi Nipendeni service, it is interesting to see how the strategy articulated at the baseline has largely come about, with more partners entering into agreements with the mHealth Tanzania-PPP to provide mobile-based services, and with the Government getting more involved and assuming more responsibility for the platform. As part of this evolution, the primary role of the mHealth Tanzania-PPP appears to have shifted from technical to health. The PPP was originally set up to develop the software and systems needed to deliver a service, but an understanding of public health now seems to be more important in dealing with MoHCDGEC and negotiating partnerships with health partners. It is also interesting to note that the current model closely resembles the original concept for the 'one-stop shop' articulated by GSMA at the beginning of the mNutrition programme. The mHealth Tanzania-PPP is the 'go to' institution in Tanzania that can help programmes entering the country to set up mobile services more conveniently, at a lower cost, and avoiding duplication, rather than setting up independent services themselves. The difference is that although the mHealth Tanzania-PPP moderates a complex partnership of public and private institutions, it itself is effectively a public body. It is funded by public money through CDC and it has no desire to become a for-profit organisation. The original GSMA vision was for a private body to act as the aggregator, or at least as a form of cooperative that would generate revenue to cover costs.

9.8 Looking to the future

The mHealth Tanzania-PPP and Wazazi Nipendeni are now approaching a crucial point in time. Firstly, the agreement providing funding for the mHealth Tanzania-PPP is due to expire shortly, and it is not yet clear whether CDC will continue to fund the PPP beyond this date. Secondly, advances in technology are leading to a next generation of mHealth services that are smartphone-based and delivered over the internet. Increasing broadband coverage and falling smartphone prices mean that these services will be accessible to more of the population in the next few years. Many new services incorporate financial services, which can enable subscriptions, purchases (e.g. of pharmaceuticals), and insurance. These emerging services are attractive to MNOs as MNO-led mobile money services are a source of increasing revenue. These services tend to be accessible only to people with higher levels of digital literacy, so they carry a risk of opening up a further digital divide between better educated users and poorer users. Thirdly, recent changes in the structure of the telecommunications market may lead to increased competition and investment. Disputes over the ownership of both Tigo and Airtel have been resolved. These disputes prevented these companies from complying with the regulator's requirement to float shares on the local stock market, so they will also have impeded any plans for investment in the network or services. Tigo's takeover of Zantel has increased its market share so that it is closer to the leader, Vodacom, and this may result in increased competition between two close contenders for market leader.

10 Conclusions

10.1 The product

The Wazazi Nipendeni service offers a strong value proposition to users. In terms of the value attributed to the service by users, over 80% of households read all the mNutrition content they received, and over 90% of users either always or very often found the messages useful. Users also expressed high levels of satisfaction with the service, as over 90% of users would recommend the service (likely or highly likely to recommend it to others). There is evidence that users translated information from the messages into action. Over 80% self-reported implementing at least one tip, most commonly on complementary feeding. Evidence of behaviour change was confirmed by the quantitative study, which found that accessing the Wazazi Nipendeni service had improved a range of nutritional outcomes, most notably multiple indicators associated with diets among young children.

The success of the early nationwide awareness campaigns was still evident in the high levels of awareness of Wazazi Nipendeni (53%) found by the DHS surveys conducted in early 2016. Most respondents to the DHS survey had heard about Wazazi Nipendeni through the radio (87%). The quantitative study found that 13% of respondents from the control sample had received messages from Wazazi Nipendeni. Awareness levels among the public as a whole would be much higher, suggesting that awareness of Wazazi Nipendeni remains high. Initial users were encouraged through media campaigns to self-register but, more recently, users have been assisted with registration by partners and health workers. The relatively limited data on opt-outs from the service indicate that users who self-registered were much more likely to opt out (42%, compared with 0.3% of users registered by a partner using the API). This confirms the value of face-to-face contact in the registration process, and appears to confirm the hypothesis that adherence is likely to be higher among users who have been assisted with registration.

SMS remains an appropriate channel for delivering information to women. Notwithstanding limitations associated with literacy and local languages, the service was highly valued by users and messages were commonly read. Having said that, it is noted that SMS may be particularly well suited to the Tanzanian context, given that literacy levels are relatively high (for sub-Saharan Africa), and the country is united by the language of Swahili.

It is important to target men with awareness raising so that they are more likely to permit partners to access phones. However, it is less important to enrol men on the system as women's access to Wazazi Nipendeni messages was less reliable if husbands received the messages, as men often did not share the phone with their partners. Men would also not share information with their partners if they disagreed with the content, e.g. information on family planning. Men were registered on the system as supporters (among others), and made up only a small proportion of Wazazi Nipendeni users (less than 1%).

Telecoms markets across Africa are shifting from voice to data, as broadband coverage increases and data accounts for a greater share of operator revenues. Smartphones are becoming more common as handset prices continue to fall, and social media, such as Facebook, WhatsApp, and Twitter, are becoming popular among the young. Although SMS currently remains the most appropriate channel for reaching the majority of the population at present, users tastes are changing, and the mHealth Tanzania-PPP will need to adopt the most effective channel for reaching the next generation of users.

10.2 Partnerships

The Wazazi Nipendeni service (and the mHealth Tanzania-PPP) can trace its roots back to one of the earliest ICT for development pilot projects (Voxiva). This illustrates the importance of a long history of investment, partnerships, and political commitment in nurturing a facility to the point where it can successfully implement an information dissemination service (and other services) at national scale. This does not necessarily mean that a start-up could not achieve something similar but brokering the complexity and diversity of the partnerships involved is not a trivial achievement.

The ability to broker a complex set of partnerships has been crucial in the success of the Wazazi Nipendeni service. Partnerships have been forged with a diverse range of stakeholder groups, including Government ministries, multiple programme funders (e.g. CDC, JHCCP), content providers (e.g. GAIN, field partners), technology providers, and partner MNOs. These partnerships have been successful due, at least partly, to the personal skills of the mHealth Tanzania-PPP team.

10.3 Business models

MNOs have an opportunity to capitalise on the positive brand of Wazazi Nipendeni by using it in promotional materials. To date, it appears that operators' promotion of Wazazi Nipendeni has been weak: Airtel released a press statement following the publication of the GSMA case study that acknowledged the contribution of MNOs; Tigo mentions Wazazi Nipendeni as part of its CSR activities under the Tanzania page of its website; and Vodacom Tanzania Foundation has a web page that describes Wazazi Nipendeni. There are additional possibilities for further engagement with Wazazi Nipendeni, such as training freelancers on registering users, and increasing or abolishing any caps on the number of messages sent. Further engagement can be justified based on the increases in ARPU found in the quantitative study.

The quantitative study has shown that the Wazazi Nipendeni service yields substantial indirect benefits to mobile operators in terms of increased ARPU. The effect size in the quantitative study area was at least a 10% increase in ARPU (TZS 510/month), and is likely to be higher still nationally. This is as a result of women becoming more confident in their use of phones. They make and receive more calls and SMS messages. This represents a real financial benefit to MNOs as a result of their contribution to Wazazi Nipendeni. As the real cost to an operator of sending SMS messages is low (tending to zero), there is no cost of sale associated with this increase in revenue. The study found no evidence that Wazazi Nipendeni users held on to their SIM cards for longer (reduced churn). This may be at least in part due to the rural nature of the Iringa district, given that churn tends to be lower in rural areas, making it difficult to achieve any differences in churn.

Demonstrating that Wazazi Nipendeni generates real revenue for operators opens up possibilities for alternative commercial business models. Analysis has focused on two hypothetical cases representing opportunities for replicating an mHealth agency delivering a service similar to Wazazi Nipendeni in another country. An in-house mHealth service developed by an MNO appears to be the most attractive proposition for two key reasons. Firstly, all of the increase in revenue is retained by the MNO and, secondly, the real cost to an operator of sending SMS messages is minimal. Based on an initial investment of £312,500 to cover the cost of product development (UX research, monitoring and evaluation, content localisation), a scenario based on positive assumptions on operating costs, ARPU, and the effect size (increase in ARPU) indicates that a service could provide an IRR of approximately 70% over a four-year period.

Less attractive, although possibly still viable, is an independent content provider model, similar to GSMA's original vision. In this case, the same investment costs have been assumed but the provider would need to pay a bulk SMS price for all messages sent (TZS 25/SMS), and it would need to enter into some kind of revenue share agreement with each participating operator. A scenario based on positive assumptions on operating costs, ARPU, the effect size (increase in ARPU), and revenue share (50%), indicates that a service could only provide a positive IRR over a six-year period.

The business model continues to be a multi-sided platform business model that provides value to funders with a health mandate (MoHCDGEC and CDC) who pay for the service, thereby enabling users to access it free of charge. One of the principal funders was MoHCDGEC, but as it assumes responsibility for more of the activities conducted by the mHealth Tanzania-PPP, including the Wazazi Nipendeni service, the business model will tend towards a hybrid of a government-to-citizen model and the multi-sided platform, as the field partners will still support both Wazazi Nipendeni and users, and the MNOs will still provide in-kind funding for messages. Although the original vision for mNutrition articulated the role of private sector investment in taking mobile services to scale, Wazazi Nipendeni shows that it is also possible for a donor funded business model to reach scale and to attract further investment, albeit from donors rather than the private sector.

10.4 Telecoms industry

Rapid staff turnover within the MNOs continues to pose a challenge for the work of the mHealth Tanzania-PPP. When support was given as part of CSR activities, it depended on personal relationships, so effort was constantly required to establish relationships with new staff. As support for Wazazi Nipendeni becomes integrated as part of commercial operations, which is increasingly the case given developments in the political economy of the telecoms industry, the importance of personal relationships may diminish.

Telecommunications companies have come under increasing pressure from the Government as it continues to exert pressure as part of its anti-corruption campaign. Companies have been required to make shares available to the Tanzanian public, and several mobile companies have been charged with a range of charges, including Vodacom, which was convicted of tax evasion. Support for Wazazi Nipendeni has political capital in this context, and operators have now signed agreements directly with MoHCDGEC rather than indirectly with the mHealth Tanzania-PPP.

The principal vulnerabilities of the current business model are funding from CDC, and the free SMS messages provided by MNOs. Through not yet secure, policy documents propose further funding for the services provided by the mHealth Tanzania-PPP (e.g. the 2018 PEPFAR country operation plan says it will expand the mHealth Tanzania-PPP, acknowledging its ability to leverage support from the MNOs; scaling up the Electronic Integrated Disease Surveillance and Response system is part of the 2023 Digital Health Investment road map). The mHealth Tanzania-PPP continues to enter into agreements with new public health programmes (e.g. PATH). Both the mHealth Tanzania-PPP and GSMA have petitioned partner MNOs to analyse user records to demonstrate indirect benefits (increased ARPU and reduced churn), but unsuccessfully to date. The quantitative study provides robust evidence of a substantial increase in ARPU (but no reduction in churn). It is hoped that this will be of value to the mHealth Tanzania-PPP as it negotiates continued and increased support from MNOs in the future.

References

Airtel Africa (2019) 'Quarterly report on the results for the fourth quarter and year ended March 31, 2019'.

Barnett, I., Batchelor, S., Gilligan, D., Haddad, L., Hidrobo, M., Ledlie, N., Palloni, G., Scott, N., and Shyam, T. (2017) 'External evaluation of mobile phone technology-based nutrition and agriculture advisory services in Africa and South Asia: Inception report'.

Barnett, I., Faith, B., and Gordon, J. (2018) 'External evaluation of mobile phone technology-based nutrition and agriculture advisory services in Africa and South Asia. Mobile phones, nutrition and health in Tanzania: Qualitative midline study report'.

Barnett, I., Faith, B., Mitchell, B., Brockerhoff, S., and Medardi, D. (2019) 'External evaluation of mobile phone technology-based nutrition and agriculture advisory services in Africa and South Asia. Mobile phones, nutrition and health in Tanzania: Qualitative follow-up study report'.

Barnett, I., Scott, N., Batchelor, S., and Haddad, L. (2016) 'Dial 'N' for Nutrition? A Landscape Analysis of What We Know About m-Nutrition, m-Agriculture and m-Development', *IDS Working Paper 481.*

Batchelor S., Scott N., and Sharp J. (2018) 'External evaluation of mobile phone technology-based nutrition and agriculture advisory services in Africa and South Asia. Mobile phones, nutrition and agriculture in Tanzania: Business Modelling Baseline Report'.

Batchelor S., Scott N., Clements A., and Jones T. (2019) 'External evaluation of mobile phone technology-based nutrition and agriculture advisory services in Africa and South Asia. Mobile phones, nutrition, and health in Tanzania: Cost Effectiveness Endline Report'.

Blackburn, J., Stanojevic, R., Erramilli, V., Iamnitchi, A., and Papagiannaki, K. (2013) 'Last call for the buffet: economics of cellular networks'. In *Proceedings of the 19th Annual International Conference on Mobile Computing & Networking*, pp. 111–122, ACM.

BMI Research (2016) 'Tanzania Telecommunications Report Q3 2016'.

CABI (2016) 'GCP spend to date and projected', Charlotte Jordan, unpublished. Last edited 14 November 2016.

Casas, C., and Lajoie, W. (2005) *The Voxiva Story*.

Christen, R., Gökgür, N., Nellis, J., and Rühl, O. (2005) 'United Republic of Tanzania Privatization Impact Assessment: Infrastructure.'

Esselaar, S., and Stork, C. (2018) 'OTTs Driving data revenue growth', 22nd Biennial Conference of the International Telecommunications Society, Seoul, 24–27 June 2018.

Field-Nguer M., Musonda K., Matee N., Mwanza M., Mwita A., Mwingizi D., Rutahindurwa F., and Ernest R. (2014). The Tanzania Capacity and Communication Project (TCCP): A Performance Evaluation.

Food and Agriculture Organization of the United Nations (2018) *FAOSTAT Statistics Database*, Food and Agriculture Organization of the United Nations, Rome.

GAIN (2016) 'GAIN/ ESOKO mAgri/ mNutrition Project. Project Sustainability Plan', Charlotte Jordan, unpublished. Last edited 01 September 2016.

Gilligan, D., Hidrobo, M., Ledlie, N., and Palloni, G. (2018) 'Mobile Phones, Nutrition, and Health in Tanzania: Quantitative Baseline Report'.

Gilligan D., Hidrobo M., Palloni G., and Tambet H. (forthcoming, 2020) 'External evaluation of mobile phone technology-based nutrition and agriculture advisory services in Africa and South Asia. Mobile Phones, Nutrition, and Health in Tanzania: Quantitative Endline Report'.

GSMA (2014) *Mobile for Development. mHealth Country Feasibility Report: Tanzania.*

GSMA (2017) 'Personal Communication. Average breakdown of costs per country; Cost estimates for Gamos'. Email received 24 August 2017. Unpublished.

GSMA (2018) 'Creating mobile health solutions for behaviour change. A study of eight services in the mNutrition Initiative portfolio'.

GSMA (2019) 'The Mobile Economy West Africa 2019'.

Independent Communications Authority of South Africa (2017) 'Number Portability Public Inquiry Findings Report'.

International Labour Organization (2018) *ILOSTAT database*. [Data retrieved 18 April 2019].

Keshav S. (2009) 'Cell Phone Text Messaging Rate Increases and the State of Competition in the Wireless Market', Senate Subcommittee on Antitrust, Competition Policy and Consumer Rights.

Mangone, E.R., Agarwal, S., L'Engle, K., Lasway, C., Zan, T., Van Beijma, H., Orkis, J., and Karam, R. (2016) 'Sustainable cost models for mHealth at scale: modeling program data from m4RH Tanzania', *PloS one 11*(1), p.e0148011.

MoHCDGEC [Tanzania Mainland], Ministry of Health [Zanzibar], NBS, Office of the Chief Government Statistician, and ICF (2016) *Tanzania Demographic and Health Survey and Malaria Indicator Survey 2015-16*, MoHCDGEC, Ministry of Health, NBS, Office of the Chief Government Statistician, and ICF, Dar es Salaam, Tanzania, and Rockville, Maryland, USA.

MoHCDGEC (2017) *Tanzania Digital Health Investment Road Map 2017–2023.*

NBS (2013) *Population Distribution by Age and Sex.* National Bureau of Statistics, Ministry of Finance Dar es Salaam, and Office of Chief Government Statistician President's Office, Finance, Economy and Development Planning Zanzibar.

NBS (2019) *Tanzania in Figures 2018.*

OECD (2010) *DAC Guidelines and Reference Series Quality Standards for Development Evaluation.*

Okeleke, K. (2019) 'Digital transformation in Tanzania: The role of mobile technology and impact on development goals', GSMA.

Osterwalder, A., and Pigneur, Y. (2010) *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*, John Wiley & Sons, London.

PEPFAR (2008) 'The Power of Partnerships: the US President's Emergency Plan for AIDS Relief', 2008 Annual Report to Congress'.

PEPFAR (2018) 'Tanzania Country Operational Plan COP 2018 Strategic Direction Summary'.

Pew Research Center (2018) 'Social Media Use Continues To Rise in Developing Countries, but Plateaus Across Developed Ones'.

Population and Housing Census (2012) 'Iringa Region: Basic Demographic and Socio-Economic Profile' technical report, NBS.

Rowntree, O. (2019) 'Connected Women The Mobile Gender Gap Report 2019', GSMA.

Scaling up Nutrition (2018) 'Joint-assessment by the multi-stakeholder platform'.

TCRA (2019). 'Mobile Number Portability Implementation MNP Porting Process'.

TCRA (2019a). 'Quarterly Communications Statistics October to December 2018'.

TCRA (2019b). 'Quarterly Communications Statistics April-June 2019'.

The Electronic and Postal Communications Act (2010).

Tricarico, D. (2016) *Agricultural Value-added Services (Agri VAS) Toolkit 2.0: How to design, develop and market next generation VAS for the rural market,* GSMA.

Vodacom (2019) 'Preliminary Consolidated financial results for the year ended 31 March 2019'.

Annex A Terms of reference

Call-down Contract

Terms of Reference

PO 6420: External evaluation of mobile phone technology based nutrition and agriculture advisory services in Africa and South Asia

Introduction

DFID (Research and Evidence Division) wishes to commission an external impact evaluation of mNutrition, a mobile phone technology based nutrition and agricultural advisory service for Africa and South Asia. mNutrition is a programme supported by DFID that, through business and science partnerships, aims to build sustainable business models for the delivery of mobile phone technology based advisory services that are effective in improving nutrition and agricultural outcomes.

mNutrition is primarily designed to use mobile phone based technologies to increase the access of rural communities to nutrition and agriculture related information. The initiative aims to improve knowledge among rural farming communities especially women and support beneficial behaviour change as well as increasing demand for nutrition and agriculture extension services. The mNutrition initiative launched in September 2013 will work in 10 countries in Africa (Cote d'Ivoire, Ghana, Malawi, Mozambique, Nigeria, Tanzania, Kenya, Rwanda, Uganda, Zambia) and four countries in South Asia (Bangladesh, India, Pakistan and Sri Lanka). The desired impact of mNutrition will be improved nutrition, food security and livelihoods of the poor.

Mobile phone based services have been endorsed by WHO as an effective strategy for behaviour change and for driving adherence to anti-retroviral treatment protocols (Horvath, Azman, Kennedy and Rutherford 2012). There is currently scant evidence on the impact and cost-effectiveness of mobile phone technology based services for nutrition and agriculture and on the sustainability of different business models for their provision. A rigorous evaluation of mobile phone technology based nutrition services would add significantly to the current evidence base. An external evaluation team managed by the Evaluator, independent of the programme delivery mechanism, will conduct an assessment of the impact, cost-effectiveness and sustainability of mobile phone technology based information and behaviour change messages for nutrition and agriculture.

Background to mNutrition

Introduction

Undernutrition is a major challenge to human and economic development globally. It is estimated that almost one billion people face hunger and are unable to get enough food to meet their dietary needs. Agriculture is a major source of livelihood in many poor countries and the sector has a potentially critical role in enhancing health, specifically maternal and child health and nutritional status. A well-developed agriculture sector will deliver increased and diversified farm outputs (crops, livestock, non-food products) and this may enhance food and nutrition security directly through increased access to and consumption of diverse food, or indirectly through greater profits to farmers and national wealth. Better nutrition and health of farmers fosters their agricultural and economic productivity. Current agricultural and health systems and policies are not meeting current and projected future global food, nutrition and health needs.

Despite major investment in agricultural and nutrition research and its uptake and application, there is significant social and geographic inequality in who benefits from these investments. Furthermore, in many developing countries, public extension systems for agriculture, health and nutrition are inefficient, have limited capacity and have a poor track record of delivery, especially in terms of supporting women and girls and the most marginalised populations (Alston, Wyatt, Pardey, Marra and Chan-Kang 2000; Anderson 2007; IFPRI 2010; Van den Berg and Jiggins 2007).

Several research and mobile network operators (MNOs) are testing a range of information and communication technology (ICT) solutions for improving access to a wide range of information and advisory services. Mobile phone based technologies are among the most promising ICT strategies, although current initiatives in nutrition are relatively small and fragmented.

What is mNutrition?

Enhancing access to the results of nutrition and agricultural research and development is potentially critical for improving the nutrition, health and livelihoods of smallholders and rural communities. mNutrition will harness the power of mobile phone based technologies and the private sector to improve access to information on nutrition, health and agricultural practices especially for women and farmers (both male and female). Specifically, mNutrition will initiate new partnerships with business and science to deliver a range of services including:

- An open-access database of nutrition and agriculture messages for use in mobile phone based communication (for example, information and behaviour change messages on practices and interventions that are known to have a direct impact on nutrition or an indirect impact via for example agriculture);
- A suite of mobile phone based nutrition and agriculture information, extension and registration services designed to: improve knowledge and generate beneficial behaviour change in nutrition and agriculture; increase demand for nutrition, health and agriculture goods and services; register and identify target populations for support; and, using real-time monitoring, support the conduct of nutrition risk assessments by community health workers.

The impacts of mNutrition are expected to include improved nutrition, food security and livelihoods of the poor, especially women in 10 countries in Africa (Cote d'Ivoire, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Tanzania, Uganda and Zambia) and 4 countries in South Asia (Bangladesh, India, Pakistan and Sri Lanka). This impact will result from the increased scale and sustainability of mobile phone based nutrition and agricultural-based information services, delivered through robust public private partnerships in each country.

mNutrition has two major outcomes. One outcome will be cost-effective, sustainable business models for mobile phone enabled nutrition and agriculture services to 3 million households in 10 countries in Africa and 4 countries in South Asia that can be replicated in other countries. Linked to this outcome, the second outcome will expect these services to result in new knowledge, behaviour change and adoption of new practices in the area of agriculture and nutrition practices among the users of these mobile phone based services.

These outcomes will be achieved through four outputs:

- Improved access to relevant mobile based health, nutrition and agricultural advisory services for 3 million poor people and community health workers across 10 SSA and 4 Asian countries;
- Launch and scaling of mobile phone based health, nutrition and agricultural advisory services targeted to poor people and community health workers;

- Generation and dissemination of high quality research and evidence on the impact, cost-effectiveness and sustainability of mobile phone based advisory services in nutrition and agriculture in South Asia and SSA; and
- Development of locally relevant content for mobile phone technology based agriculture and nutrition services meeting demands from users and community health workers.

In terms of promoting behaviour change and/or adoption of new practices, mNutrition will seek to achieve changes in one or more of the following areas:

- Adoption of new agricultural practices that are nutrition sensitive, improve agricultural productivity and utilise post-harvest technologies
- Changes in nutrition practices in either one or several knowledge domains including improved maternal nutrition practices during pregnancies; infant and young child feeding practice; and micro-nutrient supplementation to children at risk (i.e. Vitamin A, Zinc and Oral Rehydration Solution (ORS)).

mNutrition has started implementation from September 2013. For the 2 countries selected for the impact evaluation (Tanzania and Ghana), mobile network operators and content providers have been identified through a competitive process during the first half of 2014. The MNOs and content providers started developing and launching their services during the 4th quarter of 2014 and early 2015. The mobile phone based advisory services are expected to run at least till 3rd quarter of 2018.

mNutrition Project Coordination

DFID support to mNutrition will be channelled to GSMA, as well as directly to this associated independent external impact evaluation. GSMA is a global body that represents the interests of over 800 mobile operators. GSMA already works with the major mobile operators across Africa, (including Airtel, MTN, SafariCom/VodaCom) with a collective mobile footprint of more than 67 % of total African connections. GSMA has a number of existing development initiatives, including mHealth and mFarmer, that are part of GSMA's Mobile for Development which brings together mobile operator members, the wider mobile industry and the development community to drive commercial mobile services for underserved people in emerging markets. GSMA will provide technical assistance to mobile phone operators, and support new partnerships with content providers to develop and scale up new nutrition and agriculture message services. GSMA will ensure sharing of best practices and promote wider replication and uptake of effective business models.

Objective and Main Questions

The objective of this work is to conduct an external evaluation of the impacts and cost-effectiveness of the nutrition and agriculture advisory services provided by mNutrition compared to alternative advisory services available in the two selected countries (Ghana and Tanzania), with particular attention paid to gender and poverty issues. The impact assessment is required to answer the following questions that relate to impact, cost-effectiveness and commercial viability:

- What are the impacts and cost-effectiveness of mobile phone based nutrition and agriculture services on nutrition, health and livelihood outcomes, especially among women, children and the extreme poor?
- How effective are mobile phone based services in reaching, increasing the knowledge, and changing the behaviour, of the specific target groups?

- Has the process of adapting globally agreed messages to local contexts led to content which is relevant to the needs of children, women and poor farmers in their specific context?
- What factors make mobile phone based services effective in promoting and achieving behaviour change (if observed) leading to improved nutrition and livelihood outcomes?
- How commercially viable are the different business models being employed at country level?
- What lessons can be learned about best practices in the design and implementation of mobile phone based nutrition services to ensure a) behaviour change and b) continued private sector engagement in different countries?

Further evaluation questions related to other aims of mNutrition will be addressed in at least 1 country (either Ghana and/or Tanzania):

- Are mobile phone based services a cost-effective way to register and identify at risk populations to target with nutrition support?
- Are mobile phone based services a cost-effective way for community health workers to improve the quality and timeliness of data surveillance (a core set of nutrition-related indicators)?

The content for the mobile phone based advisory services will be based on international best practices and widely endorsed protocols (i.e. by the World Health Organisation) and evidence-based nutrition-sensitive agricultural practices identified by international experts. Through an iterative multi-stakeholder process, international and country experts will localise and adapt the content to make it relevant to the specific target audience in the 14 countries. The adapted content and nature of messages is expected to vary across specific target audiences within and across countries. The main purpose of assessing the relevance of the content is not to evaluate the overall health and nutrition content but on how this content has been localised and adapted and to what extent the needs of the specific target groups within their particular context have been met.

In assessing the commercial viability, it is recognised that evaluating the sustainability/long-term financial viability of the mobile phone based advisory services will be difficult as mobile network operators may not be willing to provide this potentially commercially sensitive information. Therefore, GSMA will provide support through its access to aggregated confidential financial results of the mobile network operators providing the service. GSMA will provide a financial summary report on the commercial viability of the business models without compromising the commercial sensitivity of the data for the mobile network operators. The evaluator will assess and validate commercial sustainability through an analysis of the aggregated information provided by GSMA and additional qualitative business analysis approaches.

The Evaluator has the option of proposing refinements of the existing evaluation questions during the inception phase as part of developing the research protocol. These suggestions will be considered by the Steering Committee and an independent peer review during the review of the research protocol as part of the inception phase.

Output

The output of this work will be new and robust evidence on the impact, cost-effectiveness and commercial viability of mobile phone based advisory services focusing on nutrition and agriculture delivered by public and private partners, and including the development of robust methodological approaches to impact assessment of phone based advisory services.

Recipient

The primary recipient of this work will be DFID, with the beneficiaries being GSMA, governments, international agencies, foundations, MNOs and other private companies and civil society involved in policies and programmes in nutrition and agriculture that are aimed at improving nutritional, health and agricultural outcomes. The findings of this impact evaluation are intended as global public goods.

Scope and timeline

The scope of this work is to:

- Develop a research protocol for the external evaluation of mNutrition;
- Design and undertake an external evaluation of mNutrition in two countries: Ghana and Tanzania;
- Contribute to the communication of the learning agenda, evaluation strategy and evaluation results.

The evaluation will be in two of the 14 mNutrition target countries; Ghana and Tanzania. These countries have been selected based on the phased start-up of mNutrition programme activities. The focus and approach in the two respective countries will be different allowing for a comparison of the effectiveness of approaches applied. In Tanzania, mNutrition will focus on mobile phone technology based nutrition and health services and registration and identification of target population. In Ghana, the mobile phone technology will focus on nutrition and agriculture sensitive services.

In terms of coverage in number of people being targeted for these services, in total 3 million people will be reached through mNutrition; including 2 million for nutrition sensitive agriculture advisory messages in 4 Asian and at least 2 African countries and about 1 million beneficiaries for mobile phone based nutrition services in 10 countries in SSA.

The evaluation contract period will be September 2014 to 31st December 2019. The development of the research protocol must be completed by month 4 for review and approval by DFID. Full details on tasks and deliverables are provided in sections below.

Statement on the design of the mNutrition evaluation

The evaluation design is expected to measure the impact, cost-effectiveness and commercial viability of mNutrition, using a mixed methods evaluation design and drawing on evidence from two case study countries and the M&E system of the programme. Overall, the proposed design should ensure that the evidence from the two case study countries has high internal validity and addresses the priority evidence gaps identified in the Business Case. Being able to judge the generalisability/replicability of lessons learned from the programme is of equal importance and so a credible approach to generalization and external validity will be an important component of the overall evaluation design. The final evaluation design and methodology to generate robust evidence will be discussed in detail with DFID and GSMA before implementation.

For assessing cost-effectiveness, the Evaluator will further fine-tune their proposed evaluation approach and outline their expectations in terms of data they will require from implementers. A theory based evaluation design, using mixed methods for evaluating the impact has been proposed. During the inception phase, the Evaluator will put forward a robust evaluation design for the quantitative work, either an experimental or a quasi-experimental method, with a clear outline

of the strengths and limitations of the proposed method relative to alternatives. During the inception phase, the Evaluator is also expected to identify clearly what will be the implications of the design for implementers in terms of how the overall programme would be designed and implemented and for evidence to be collected in the programme's monitoring system. The Evaluator will also assess the degree to which it is realistic to assess impacts by early 2019 for a programme where implementation started mid-2015 and, if there are challenges, how these would be managed.

The Evaluator, in its 6 monthly reports, will be required to provide information to feed into the DFID Annual Review and Project Completion Report of mNutrition.

Gender and inclusiveness

The impact evaluation will pay particular attention to gender and other forms of social differentiation and poverty issues. From current experiences, it is clear that access to and use of mobile services is differentiated along a range of factors, including gender, poverty, geographic marginalisation, education and illiteracy levels. Therefore, the impact evaluation will look at and analyse differentiated access to and potential utilisation of mobile phone based services for improved nutrition and agricultural production. Based on the findings, it will identify opportunities and challenges in having an impact on women in general and more specifically the poor and the marginalised.

Tasks

The Evaluator will perform the following tasks:

A. Finalise a coherent and robust evaluation approach and methodology based on their proposal (inception phase)

- Conduct landscape analysis of existing experiences in mobile phone based services for nutrition and agriculture based on available publications and grey project documents to identify additional critical lessons and priorities for evidence gathering and programme design and implementation;
- Ensure that gender issues and poverty issues are well integrated into the impact evaluation design;
- Develop robust sampling frameworks, core set of indicators and research protocols that allow the consistent measurement and comparison of impacts across study countries, taking into account differences in business models and programmes as needed;
- Work closely with mNutrition programme team in GSMA to familiarise them with impact assessment methodology, discuss evaluation approaches, identify and agree on data provided by programme monitoring system and possible modifications to design;
- Identify risks to the evaluation meeting its objectives and how these risks will be effectively managed;
- Review existing evaluation questions and if deemed relevant propose refinement of existing questions and/or add other questions;
- Prepare a research protocol, including an updated workplan, project milestones and budget. The research protocol will be subject to an independent peer review organised by DFID; and
- Develop a communication plan.

B. Implement and analyse evaluations of impact, cost-effectiveness and commercial viability in accordance with established best practices

- Based upon the agreed evaluation framework, develop and test appropriate evaluation instruments which are likely to include data collection forms for households, community health workers, service providers including health and agricultural services, content providers and private sector stakeholders including mobile network operators. Instruments will involve both quantitative and qualitative methods;
- Register studies on appropriate open access study registries and publish protocols of studies where appropriate;
- Conduct baselines and end-lines, qualitative assessments and business model assessments in both of the two impact evaluation countries;
- Conduct and analyse the evaluations and present findings in two well-structured reports addressing the evaluation questions. The reports should follow standard reporting guidelines as defined by, for example, the Equator Network. Primary findings should be clearly presented along with a detailed analysis of the underlying reasons why the desired outcomes were/were not achieved;
- The Evaluating Organisation or Consortium may subcontract the administration of surveys and data entry, but not the supervision of those tasks, study design, or data analysis; and
- The country-specific mixed methods evaluation reports, cost effectiveness and business models studies and final evaluation report will be subject to an independent peer review organised by DFID.

C. Contribute to the communication of the learning agenda, impact evaluation strategy, and evaluation results.

- Develop a communication plan outlining the main outputs and key audiences;
- Conduct lessons learnt workshops in each of the 2 impact evaluation countries and key dissemination events; and
- Assist in communicating the results of the evaluation and contribute to the development and communication of lessons learnt about mobile phone based extension approaches in nutrition and agriculture.

Deliverables

The Evaluator will deliver the following outputs[39]**:**

During the design and study inception phase of maximum 4 months:

- A publishable landscape analysis report highlighting lessons learnt from existing initiatives on mobile phone based advisory services related to nutrition and agriculture by month 4;
- A updated work plan with project milestones and budget by end of month 1 (possibly adjusted based on the approved research protocol by month 4);
- A communication plan outlining the key outputs, audience and timeline for review and approval by month 4; and

[39] Exact timeframe of deliverables will be agreed during the design phase as appropriate.

- A full research protocol by month 4 for review and approval. The research protocol should be registered with appropriate open access study registries;

Interim reports:

- 4 biannual progress reports for the External Evaluation as a whole, and for each country evaluation, against milestones set out in the workplan;
  - Two desk reviews submitted by June 2016
  - Two Baseline quantitative reports submitted by April 2017
  - Two Baseline qualitative reports submitted by February 2017
  - Two Cost-effectiveness reports 1 submitted by March 2017
  - Two Business Model reports 1 submitted by March 2017
  - Two Mixed Methods Baseline reports completed by September 2017
  - Two Midline qualitative reports submitted by March 2018
- All survey data collected during the evaluation provided in a suitable format to DFID for public release.

At project's end:

- Two Endline quantitative reports submitted by June 2019
- Two Endline qualitative reports submitted by August 2019
- Two Cost-effectiveness report 2 submitted by July 2019
- Two Business Model report 2 submitted by July 2019
- Two Evaluation reports submitted by October 2019
- At least 1 article, based on the findings from the country evaluation reports, published in a research journal;
- A shared lesson learnt paper published and at least one presentation highlighting key lessons for similar initiatives of promoting mobile based technologies for providing extension services and the promotion of uptake of technologies by December 2019.

Research protocol and all final reports will be independently peer reviewed. This will be organised by DFID. Outputs are expected to be of sufficiently quality so that a synthesis of findings can be published in a leading peer-reviewed journal.

Coordination and reporting requirements

A mNutrition Advisory Group (AG) will be established for the programme which will a) provide technical oversight and b) maximise the effectiveness of the programme. The Advisory Group will meet on a bi-annual basis and comprises of representatives of DFID, NORAD and GSMA representatives and independent technical experts. The Evaluator will be managed by DFID on behalf of the mNutrition Advisory Group. The Evaluator will work closely with the mNutrition programme team in GSMA and its specific country implementing partners. The Evaluator will:

- Ensure coherence and lesson learning across all pilot impact assessments on the key evaluation questions and indicators identified.
- Incorporate a clear code of ethics; incorporate plans for open access publications and public access to data sets.

The Evaluator will work closely with the mNutrition project management team, in particular in the design of the overall evaluation framework and the evaluation plan for the specific project components and the countries selected for the evaluation. Collaboration and regular communication between Evaluator and mNutrition project management team and implementing partners in selected case study countries is crucial as the evaluation design may have implications for project implementation and vice versa. The mNutrition project management team will lend support in communication as requested by the Evaluator or the Advisory Group. The Evaluator will report directly to DFID who will manage the evaluation on behalf of the mNutrition Advisory Group. The main point of contact for technical matters is Louise Horner, Livelihoods Adviser and Hugh McGhie, Deputy Programme Manager for all other project related issues. The mNutrition Advisory Group will be the arbiter of any disputes between the evaluation function and the overall programme implementation.

At the end of each 6 months, the Evaluator will submit a brief report outlining key achievements against the agreed deliverables. Pre-agreed funding will then be released provided that deliverables have been achieved.

In addition to the 6 monthly reports outlined above, the Evaluator will provide information to feed into the DFID Annual Review of mNutrition. The 6 monthly reports will be a key source of information used to undertake the Annual Review and Project Completion Report for the programme. These reviews will be led by the Livelihoods Adviser and Deputy Programme Manager, in consultation with the mNutrition AG. All reviews will be made available publicly in line with HMG Transparency and Accountability Requirements.

Mandatory financial reports include an annual forecast of expenditure (the budget) disaggregated monthly in accordance with DFID's financial year April to March. This should be updated at least every quarter and any significant deviations from the forecast notified to DFID immediately. In addition the Evaluator will be required to provide annual audited statements for the duration of the contract.

Contractual Arrangements

The contract starts in September 2014 and will run till end of December 2019 subject to satisfactory performance as determined through DFID's Annual Review process. Progression is subject to the outcome of this review, strong performance and agreement to any revised work plans or budgets (if revisions are deemed appropriate).

A formal break clause in the contract is included at the end of the inception period. Progression to the implementation phase will be dependent on strong performance by the Evaluator during the inception period and delivery of all inception outputs, including a revised proposal for implementation period. Costs for implementation are expected to remain in line with what has been agreed upon for this contract, with costs such as fee rates fixed for contract duration. DFID reserves the right to terminate the contract after the inception phase if it cannot reach agreement on the activities, staffing, budget and timelines for the implementation phase.

DFID reserves the right to scale back or discontinue this assignment at any point (in line with our Terms and Conditions) if it is not achieving the results anticipated. The Evaluator will be remunerated on a milestone payment basis. DFID has agreed an output based payment plan for this contract, where payment will be explicitly linked to the Evaluator's performance and effective delivery of programme outputs as set out in the ToR and approved workplan. The payment plan for the implementation phase will be finalised during the inception period.

Open Access

The Evaluator will comply with DFID's Enhanced and Open Access Policy. Where appropriate the costs of complying with out open access policy should be clearly identified within your commercial proposal.

Branding

The public has an expectation and right to know what is funded with public money. It is expected that all research outputs will acknowledge DFID support in a way that is clear, explicit and which fully complies with DFID Branding Guidance. This will include ensuring that all publications acknowledge DFID's support. If press releases on work which arises wholly or mainly from the project are planned this should be in collaboration with DFID's Communications Department.

Duty of Care

The Evaluator is responsible for the safety and well-being of their Personnel (as defined in Section 2 of the Contract) and Third Parties affected by their activities under this contract, including appropriate security arrangements. The Evaluator is responsible for the provision of suitable security arrangements for their domestic and business property. DFID will share available information with the Evaluator on security status and developments in-country where appropriate.

The Evaluator is responsible for ensuring appropriate safety and security briefings for all of their Personnel working under this contract and ensuring that their Personnel register and receive briefing as outlined above. Travel advice is also available on the FCO website and the Evaluator must ensure they (and their Personnel) are up to date with the latest position.

The Evaluator has confirmed that:

- The Evaluator fully accepts responsibility for Security and Duty of Care.
- The Evaluator understands the potential risks and have the knowledge and experience to develop an effective risk plan.
- The Evaluator has the capability to manage their Duty of Care responsibilities throughout the life of the contract.

Annex B Stakeholder contact list

Organisation	Contact
GSMA	Natalia Pshenichnaya (head of mNutrition)
GSMA	Alexander Roche (business intelligence mHealth)
GSMA	Diana Sang (representative for Tanzania)
GSMA	Willie Ngumi
GSMA	Mojca Cargo
GSMA	Kate Zechner
GSMA	Tobias Wacker (user research)
GAIN	Kyla Stockdale (senior programme manager)
mHealth Tanzania-PPP	Muttah Saulo (monitoring and evaluation)
mHealth Tanzania-PPP	Ms Janita Ferentinos
mHealth Tanzania-PPP	Peter Maro (team lead)
mHealth Tanzania-PPP	Said Ali Karume (IT adviser)
mHealth Tanzania-PPP	Mr Francis Chiduo
Cardno	Violet Ketani (programme manager; P4 Project)
MoHCDGEC	Walter Ndesanjo (ICT officer, ICT Unit)
MoHCDGEC	Leyla Bungire (programme officer – nutrition)
MoHCDGEC	Hermes Sotter (Ministry of Health eHealth)
MoHCDGEC	Dr Azma Simba (Ministry of Health)
MoHCDGEC	Dr Joyceline Kaganda
MoHCDGEC	Ms Valeria Milinga
MoHCDGEC	Mr Peter Kaswahili
MoHCDGEC	Deus Gwanchele
TFNC	Ms Victoria Kariathi
TFNC	Elizabeth Lyimo (maternal, infant and young child nutrition team)
TFNC	Mrs Maria Msangi
Nutrition International	Mr Daniel Nyagawa
Viamo	Hannah Metcalfe
Family Health International 360 – USAID Tulonge Afya	Mr Marcos Mzeru
Totohealth	Felix Kimaru (CEO)
IMA World Health	Mr Joseph Mugyabuso
COUNSENUTH	Ms Belinda Liana
Tigo	Ms Halima Okash
UNICEF	Ms Tuzie Ndekie

Annex C Review of the business model

C.1 Introduction

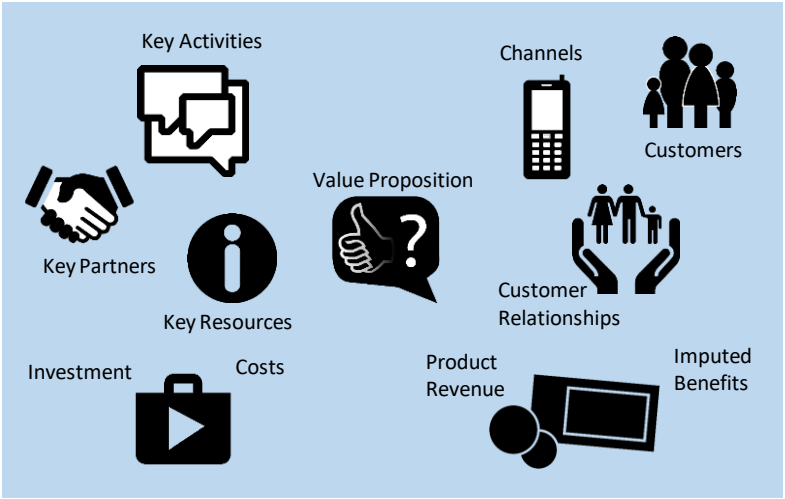
This section is structured around the Osterwalder and Pigneur canvas building blocks, summarising the key observations made in the baseline report and then supplementing the narrative with additional findings from the intervening period, as well as findings from both the qualitative and quantitative studies.

C.2 The Osterwalder and Pigneur framework

The O&P framework is commonly used as a framework or canvas for describing a business model. Businesses rarely have a simple model of selling a product and gaining revenue from that product. A simple income vs expenditure model rarely describes the business. Instead, a product might enhance the brand of a company, or enhance the overall experience of the consumer, causing them to buy other associated goods or services. This idea was at the very heart of the submission of GSMA to FCDO. The logical framework of the GSMA grant application, described in the next section, discusses indirect benefits or imputed benefits.

In order to map the various components of the business model and to capture these indirect or imputed effects (beneficial or otherwise), we use the O&P canvas. The nine elements (or building blocks) of the canvas form the basis of our analysis below (see Figure 23). Note that we propose amending the framework slightly by splitting the Revenue building block into two components, considering cash generated and imputed benefits separately, and splitting Costs into two, considering operating costs and previous investments separately. This has been proposed because of the importance of indirect costs to VAS business models, and because some of the key resources brought to partnerships have benefited from prior investments. Table 5 presents a generic overview of the framework, i.e. the descriptions and example questions illustrate how the framework is applied to business models in general, so not all are directly relevant or applicable to the Wazazi Nipendeni service.

Figure 23 Building blocks in the canvas (derived from Osterwalder and Pigneur (2010))



Source: Authors

Table 5 Description of Building blocks in the canvas[40]

Canvas building block	Description	Example Questions
Customers		
Customer Segments	The business model should define different groups of people or organisations to reach and serve. Distinct segments will have common needs, behaviours, or other attributes. The business model should be designed around a strong understanding of customer needs.	For whom are we creating value? Who are our most important customers?
Channels	How a company communicates with customer segments. Channels are customer touch points that shape the customer experience, e.g. communication, distribution, sales.	How are we reaching customer segments? How do they want to be reached? Which ones work best and are most cost-efficient?
Customer Relationships	The types of relationships a company establishes with specific customer segments. Relationships may be driven by various motivations, e.g. customer acquisition, customer retention, boosting sales.	What type of relationship does each of our Customer Segments expect us to establish with them? How costly are they? How are they integrated with the rest of our business model?
Offering		
Value Propositions	The bundle of products and services that create value for a specific Customer Segment by satisfying a need or helping solve a problem. Value propositions may be innovative (disruptive) or similar to others, but with added features.	What value do we deliver to the customer? Which of our customers' problems are we helping to solve? Which needs are we satisfying?
Business Operations		
Key resources	Those assets required to make the business model work. Resources that allow and enterprise to create and offer the value proposition, to reach markets, to maintain relationships, and to generate revenues. They can be physical, financial, intellectual, or human.	What key resources do value propositions require?
Key activities	Things a company must do to make its business model work. Activities required to create and offer the value proposition, to reach markets, to maintain relationships, and to generate revenues.	What activities do value propositions require?
Key partnerships	The network of suppliers and partners that make the business model work. Companies forge partnerships for many reasons, e.g. reduce risk, acquire resources.	Who are our key partners? Who are our key suppliers? Which key resources are we acquiring from partners? Which key activities do partners perform?
Finances		
Revenue streams	The cash generated from each Customer Segment. Revenue streams will depend on what customers are willing to pay. Revenue streams can be either one-off payments, or recurring revenues. Each revenue stream may have different pricing mechanisms.	For what value are customers willing to pay? How are they currently paying? How would they prefer to pay? How much does each revenue stream contribute to overall revenues?
Cost structure	Costs incurred to operate the business model. Creating and delivering value, maintaining customer relationships, and generating revenue all incur costs.	What are the most important costs inherent in our business model?

[40] Authors' table, generated from Osterwalder and Pigneur (2010).

Canvas building block	Description	Example Questions
		Which key resources are most expensive? Which key activities are most expensive?
Investment	Number of investors, type of investors, and commitments made to investors. These will influence acceptable profit margins, and may affect cash flow.	Who has invested in the company? What kind of returns are expected? And over what timescales?
Indirect benefits	Ways in which the service can benefit the company other than by direct revenue generation.	How does service increase acquisition and loyalty? Does service boost other sales? How does service improve brand image?

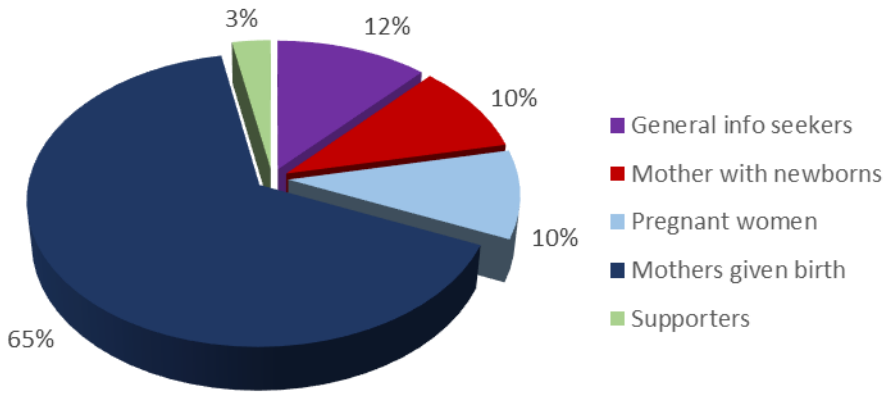
C.3 Customer segments

At registration, users are allocated to one of four categories:

- pregnant women;
- mothers with newborns;
- supporters (of pregnant women or young mothers); and
- general interest.

The registration database provided by the mHealth Tanzania-PPP covers users registered onto the system during a two-year period from November 2016 to November 2018. During this time, many women who were originally registered as pregnant women had given birth, and were then re-categorised on the system as mothers with newborns. Figure 24 shows that these women make up the vast majority of active users.

Figure 24: Mix of active users (as at November 2018)



Source: Authors

Phone ownership and access are key to accessing the Wazazi Nipendeni service. Having at least one household member that owned a phone was part of the screening criteria for the quantitative study, so it cannot provide any insights into linkages between the service and phone ownership. The qualitative study found that many women did not own a mobile phone, but across Tanzania as

a whole 77% of women own a phone, compared with 86% of men, giving only an 11% gender gap (Rowntree, 2019), although this GSMA report shows that the gap is higher in rural communities.

In terms of access, men were reluctant to let their wives have phones, fearing they would be used to facilitate affairs, and women themselves recognised that phone ownership can cause problems in the family because of trust issues. Among young, married women, who are the primary customer segment, it tends to be husbands who control their access to phones, either through consent to ownership, by buying a handset/ SIM for their wives, or by sharing their own phones with their wives.

Given this understanding of household gender dynamics, men are recognised as a key customer segment and were targeted in the Wazazi Nipendeni campaign materials, which focus on the role of couples in bringing up children. However, Figure 24 indicates that supporters, the category that includes husbands (among others, such as mothers-in-law), make up only a small proportion of Wazazi Nipendeni users.

The quantitative research specifically addresses these gender issues and was designed to explore the impact of actively engaging men in health messaging on health outcomes. It included a second stage of randomisation in which households where both pregnant women and their partner own distinct mobile phones were split into two groups – in one group only the woman received the messages, and in the other group both men and women received messages. The study found that 'estimates for the households that received the content on both mobile phones (the T-F+M group) are, in general, not distinguishable from zero and occasionally suggest that these households perform worse than those assigned to just receive the content on the primary female's mobile phone (the T-F group).' (Gilligan *et al*., forthcoming, 2020).

This is a particularly interesting finding as it appears counterintuitive. Notwithstanding the characteristics of the sub-sample used for this experiment (households in which both the mother and father owned a mobile phone tended to be better off), it suggests that women were not substantially constrained by their partners in their ability to take action based on messages. Note that this finding does not contradict findings from the qualitative study on the importance of enlisting men's support for (if not participation in) the Wazazi Nipendeni service as a means of facilitating women's access to content. For example, the quantitative study found that women's access to Wazazi Nipendeni messages was less reliable if husbands received the messages, as they often did not share them with their partners. They also found that men often disagreed with some content, particularly that on family planning, in which case they would withhold access to the messages and would not share information with their partners.

As a national service that is available through multiple networks, Wazazi Nipendeni is available all across the country, wherever there is network coverage. It does not, therefore, have a particular poverty focus – it is not specifically targeted at poor or rural families. GSMA found that the service was reaching people with less education, primarily due to assisted registrations. Registrations were assisted by field partners, who were running programmes that tended to focus on more rural areas. These users, therefore, tended to have lower income and education levels. Interestingly, the quantitative study found some evidence that the effect on child diets was larger among better off households (in the study sample). There are many characteristics of better off households that could account for this:

- they are more likely to have access to other sources of nutrition information, such as government health workers, health facilities, or more knowledgeable peers;
- individuals in wealthier households may have higher rates of literacy and education, making them better able to understand messages;

- they have more cash to implement recommendations in messages, e.g. purchasing animal-sourced foods.

The fact that the service is text based (in Swahili) will mean that it is likely to be of limited value to illiterate sections of the population. The qualitative study found examples of literate men sharing messages with their illiterate partners. Having at least one household member who was literate in Swahili was one of the screening criteria for the quantitative survey, so it was not able to explore linkages with literacy.

C.4 Value proposition

The original Wazazi Nipendeni multimedia campaign directed women to health services, and to the text messaging service provided by the mHealth Tanzania-PPP. The aim of the SMS content was to encourage women to avail themselves of health services targeted at improved neonatal health outcomes. This content covered a range of pregnancy and motherhood topics, and included a number of nutrition-related messages. The GSMA mNutrition project strengthened the service by contributing substantial additional nutrition content. A first set of messages were added that coincided with the scope of the Wazazi Nipendeni existing messages (covering pregnancy and up to 16 weeks post-partum), and a further 128 messages were added later, covering life stages up to five years.

The mHealth Tanzania-PPP brought to the GSMA mNutrition partnerships a pre-existing database of messages targeting pregnant women and new mothers, which had been developed over a number of previous partnerships, each of which had a slightly different thematic focus. Messages covered several pregnancy and motherhood related topics, not just nutrition. The list of topics includes:

- prevention of mother-to-child transmission of HIV/Aids;
- antenatal care;
- family planning;
- malaria prevention;
- nutrition (for mother and baby);
- danger signs;
- having an individual birth plan; and
- post-partum care.

A key feature of the GSMA mNutrition programme content generation process was its emphasis on quality of information. The global content partnership[41] was responsible for identifying relevant content and specifying content validation and quality control processes. After the original ‘one-stop shop’ concept was abandoned, Every1Mobile (UK-based) and COUNSENUTH, a Tanzanian NGO working in nutrition, worked together to localise the content to make it relevant and accessible to Tanzanian users. TFNC was instrumental in ensuring that the content was accessible and consistent with national nutrition strategies. TFNC shared its responsibilities with other members of the National Nutrition Social and Behaviour Change Communication Technical Working group (SBCC TWG).

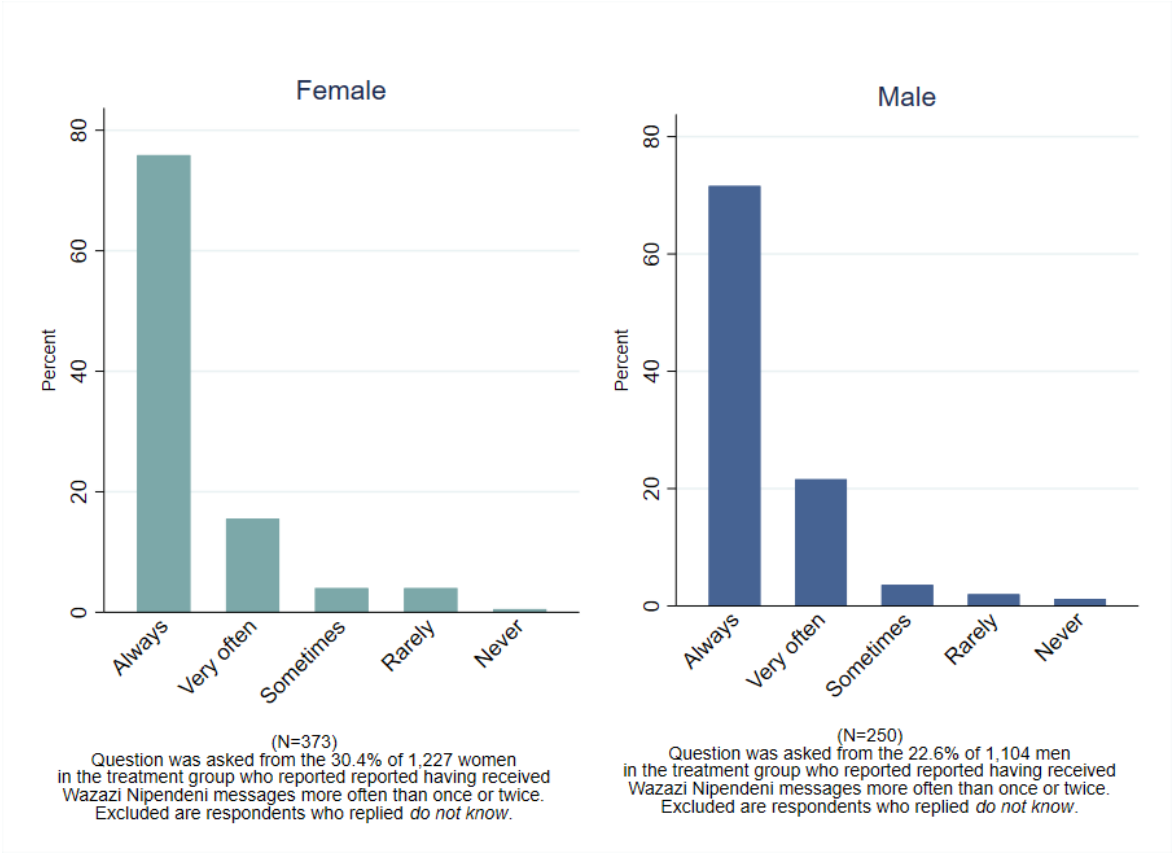
UX research was conducted early on in the project to ensure that messages were appropriate. GeoPoll tested a small sub-sample of messages for comprehension and relevance. It sent SMS

[41] CABI, GAIN, Oxfam, the International Livestock Research Institute, and the British Medical Journal.

messages to two groups of 25 women, followed by a series of evaluation questions, also sent by SMS. ThinkPlace conducted user focused research using human-centred design principles. The research was based on semi-structured individual interviews and user profiling. They then generated a set of four 'personas' intended to assist with the design of the messages. Frog later conducted further UX research based on in-depth interviews with 16 participants, which added an additional three personas. These research activities, funded through the mNutrition programme, helped with two aspects of product development: the GeoPoll and ThinkPlace activities looked at the messages and how they might fit with different types of consumers (the archetypes), while the Frog research considered how to improve the customers' experience of the service.

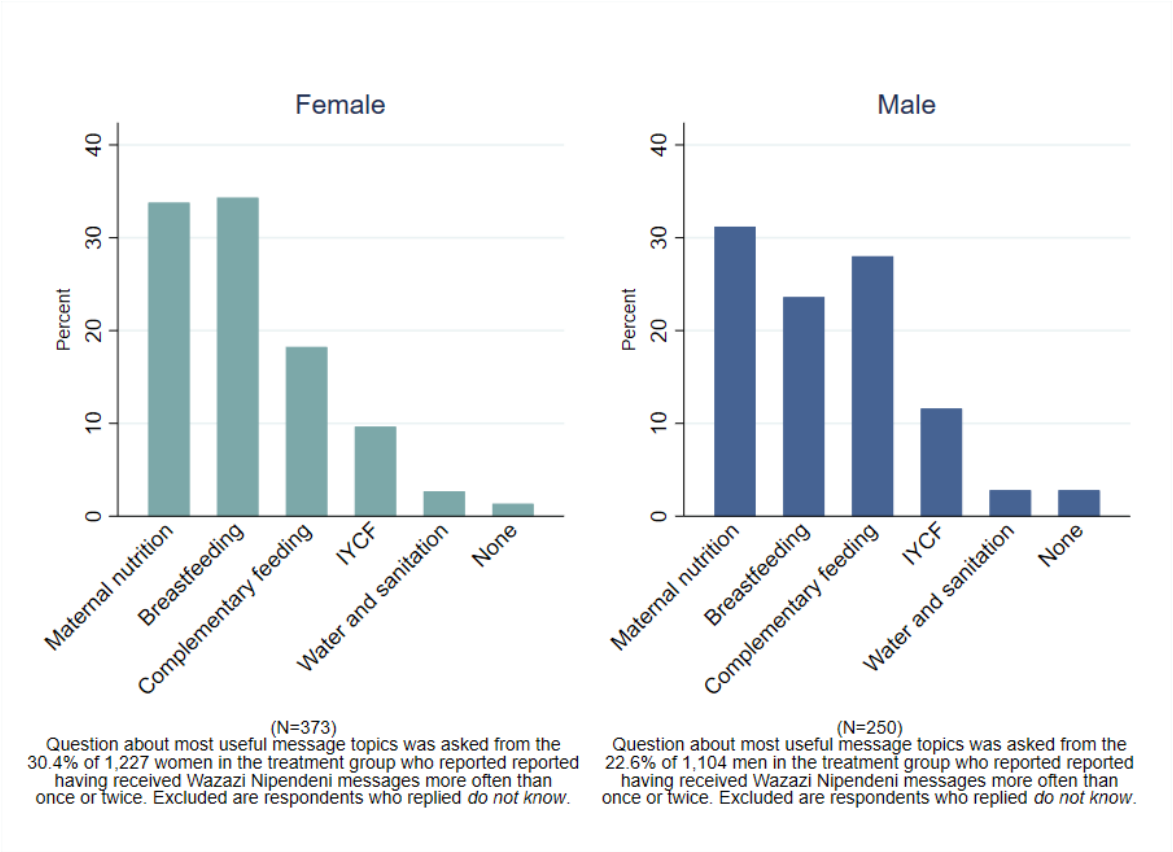
Evidence from the quantitative study appears to confirm the quality of messages. Household members in treatment households were overwhelmingly likely to read the mNutrition content they received on their phone. Between 82.7% and 91.6% of households read all the mNutrition content they received. Not reading any of the received mNutrition messages was extremely uncommon (only between 0.1 and 1.3 % of households). This indicates that the messages are highly valued, and this is confirmed by the finding that over 90% of users either always or very often found the messages useful (see Figure 25). Figure 26 shows that information on maternal nutrition was regarded as most useful (but not by a large margin). The quantitative study also found that over 90% of users (93.5% of females and 92.2% of males) would recommend the service (likely or highly likely). Conversely, only 1% of users would not recommend the service. These data suggest a high level of satisfaction with the content in the mNutrition service.

Figure 25: How often was the mNutrition content deemed to be useful?



Source: Gilligan *et al.,* (forthcoming, 2020)

Figure 26: Most and least useful mNutrition message topics, by gender



Source: Gilligan *et al.,* (forthcoming, 2020)

Perhaps more importantly, most users reported having taken action based on the messages received. 89% of females and 81% of males self-reported implementing at least one tip. The types of information that users were able to implement are presented in Figure 27. Interestingly, maternal nutrition, which was regarded as the most useful area of information, was least likely to have been acted on. There may be additional barriers to adopting these behaviours that information alone is not able to overcome.

Findings from the quantitative study appear to confirm that users did indeed change their behaviours, as it found that accessing the Wazazi Nipendeni service had improved a range of nutritional outcomes. Diets among young children in the treatment sample had improved, as follows:

- Dietary diversity for children aged 6–35 months – The number of food categories consumed increased by 0.107 (p-value 0.073).
- The likelihood that children aged 6–35 months met the minimum dietary diversity – Children in the treatment communities were 3.8 percentage points more likely to have consumed from four food groups (p-value 0.093).
- Children aged 6–23 months in the treatment communities were 6.9 percentage points more likely to satisfy minimum acceptable diet.

Note that households were included in the baseline sample if they had a pregnant woman or a child under the age of 12 months, so by the time of the endline survey children would have been aged between 18 to 36 months, so this is the age group for which it might be expected to find the strongest effects.

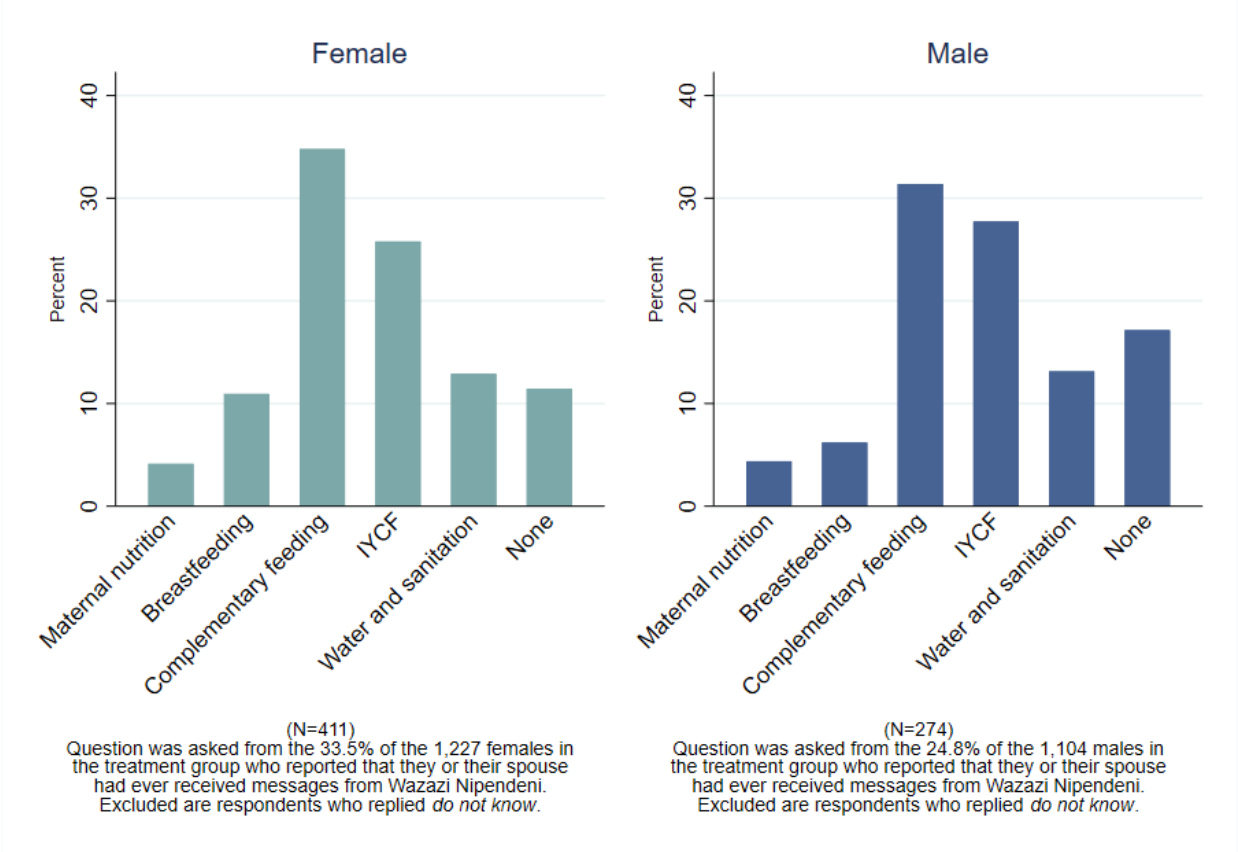
Diets among women of reproductive age (primary females) had also improved:

- The likelihood that the primary females satisfied **minimum dietary diversity for women** had increased by 4.0 percentage points (p-value 0.062).

Secondary outcomes relating to knowledge and behavioural practices had also improved:

- There were improved knowledge of IYCF practices among men.
- There was a statistically significant impact on the combined household-level measure of nutrition knowledge.

Figure 27: Which tips from mNutrition content have respondents put in practice, by gender?



Source: Gilligan *et al.*, (forthcoming, 2020)

The text messages provide women with information that is consistent with advice given by health workers in the field. Where women are in contact with health workers, the text messaging service then has the additional benefit of reinforcing the advice that women receive from multiple sources.

C.5 Channels

The multimedia campaign targeted users through a comprehensive range of channels:

- mass media: TV, radio, newspapers, and magazines;
- print media: brochures, billboards, and vinyl banners;
- other promotional items: stickers, tyre covers, t-shirts, bags, kanga;
- electronic media: SMS service, blog; and

- social media: community events, Facebook.

The 2015 Tanzania DHS survey asked respondents about the Wazazi Nipendeni campaign. Over half of respondents had heard of Wazazi Nipendeni (Table 6). Radio was clearly the single channel that achieved greatest reach: 87% of people had heard about Wazazi Nipendeni from the radio (Table 7). About a quarter of respondents had heard about the campaign on the television, with another quarter doing so through printed media (poster/ magazine/ newspaper/ billboard).

Table 6: Responses to question 'Have you heard of the Wazazi Nipendeni campaign?'

Have you heard of Wazazi Nipendeni?	Frequency	%
No	4,835	47%
Yes	5,398	53%
Total	**10,233**	**100%**

Source: Tanzania DHS Survey (2015)

Table 7: Responses to question 'How did you hear about the Wazazi Nipendeni campaign?'[42]

How did you hear about Wazazi Nipendeni?	Frequency (n=5,398)	%
Radio	4,710	87%
Television	1,463	27%
Poster/ magazine/ newspaper/ billboard	1,186	22%
Family/ friend	582	11%
Community health worker	459	9%
Health facility	421	8%
Does not know/ remember	80	2%
Mobile phone	61	1%
Internet	17	0%
Other	1	0%

Source: Tanzania DHS Survey, (2015)

During the initial campaign as part of the Tanzania Capacity and Communication Project (TCCP), printed materials were distributed to a range of health facilities where women come into contact with health professionals, e.g. hospitals, health centres, dispensaries. The mHealth Tanzania-PPP worked in partnership with the health sector, providing training for health professionals, who were then able to help women register on the system. There are three ways of registering for the Wazazi Nipendeni text messaging service:

- Assisted by health facility worker – women can be signed up when they come for antenatal care visits etc.
- Assisted by community health workers – community workers can sign women up when they visit them in their homes, or other local venues.

[42] Multiple response – respondents may have heard of Wazazi Nipendeni through multiple channels, i.e. adds up to more than 100%.

- Self-registration – instructions were given in the multimedia campaign. People dial the short code and then are guided through a small number of profiling questions (category of user, and stage of pregnancy/ age of child).

Registration data show that 57% of users were registered by partners. In addition, a proportion of other users will also have been helped to register by government health workers. Partners generally register users through the USSD service or the API. It is not possible to determine exactly how many of the 43% of 'other' users actually registered by themselves, but 59% were registered using USSD, suggesting that they were in fact registered, or at least assisted with their registration, by a partner. This means that *up to* 83% of users were registered by partners. This highlights the importance of partners in getting users onto the system.

Although mass media channels can be effective in raising awareness of the Wazazi Nipendeni campaign, it is partners that are instrumental in converting people into users. People may lack a sufficiently detailed understanding of the product to convince them to register for themselves, whereas some personal contact can help get them signed up. TFNC also believes that people who register with a health professional will have a positive bias to comply with messaging, have a better understanding of how the service works, and be more likely to appreciate how they can benefit from the service. It is likely to be known and trusted individuals who are most influential in assisting with registrations, e.g. community health workers, and community and religious leaders.

Wazazi Nipendeni was one of five programmes supported by the Tanzania Capacity and Communication Project (TCCP) (see Section 4.3). This was a multi-media behaviour change communications programme aimed at improving a range of health issues, with a focus on HIV prevention. The five year programme started in 2010 and finished in 2016, so it will have achieved nearly maximum reach towards the end of 2015, when the DHS survey referred to in Table 6 was conducted.

A USAID evaluation gives a total budget for the programme of 56 million USD (Field-Nguer *et al*., 2014). The budget is not disaggregated by project, but by health issue. At the time, Wazazi Nipendeni was addressing maternal and child health, malaria, PMTCT and family planning. The total budget allocated to these issues was 19 million USD, so the amount allocated to Wazazi Nipendeni would be some fraction of this. In principle, the user numbers achieved by Wazazi Nipendeni could be at least partly a result of this investment. Although awareness of Wazazi Nipendeni was high in 2015, this was not evident during the qualitative studies carried out as part of the evaluation. The issues were not raised during focus group discussion, and only in the midline survey, which specifically explored implementation issues, was any reference made to the legacy of TCCP:

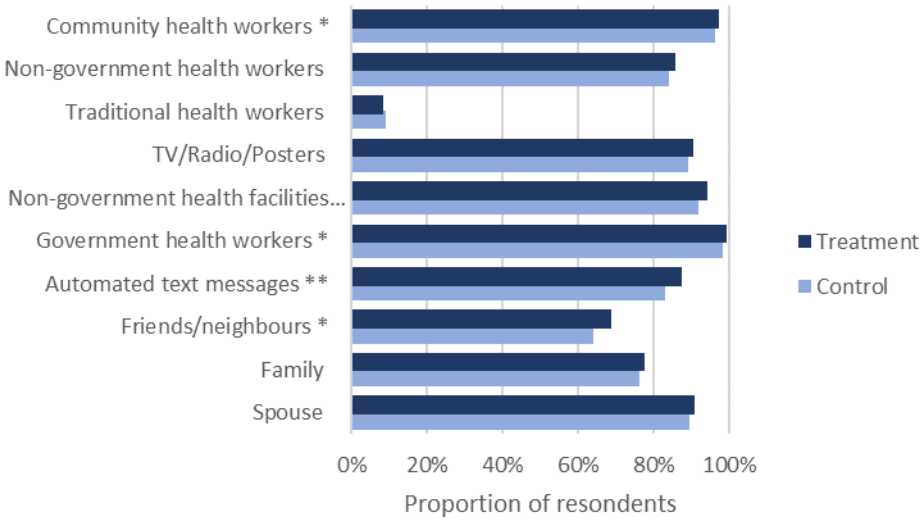
> *"Both women lived in towns in other regions during that time and had signed up themselves after seeing a poster in the health clinic."* (Barnett *et al*., 2018).

It has been shown above that the majority of users were registered by partners. These figures suggest that registration is driven by face-to-face interactions with health workers. Further research would be needed to specifically investigate the extent to which registrations continue to be influenced by any residual awareness of Wazazi Nipendeni from the TCCP activities.

Figure 28 confirms that health workers are the most highly trusted sources of information on health matters (government more so than NGO facilities). It is interesting to note that even among control communities, people have high levels of trust in information from automated text messages. They are more likely to trust an SMS than family members, confirming that text messages are regarded as being reliable and of high quality. Patterns of who people actually get information from (Figure

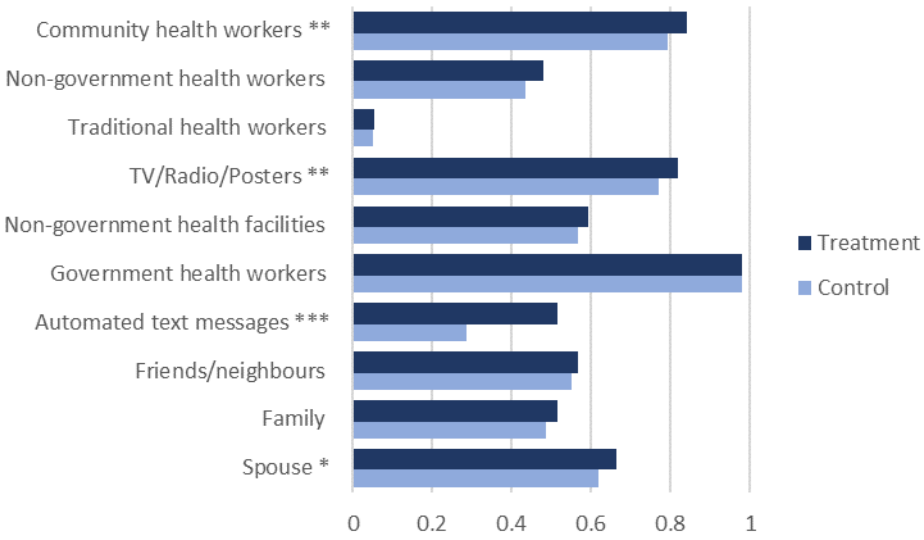
29) broadly reflect levels of trust, although they emphasise the importance of government health workers.

Figure 28: Trust in sources of health information[43]



Source: Authors

Figure 29: Sources of health information



Source: Authors

At baseline, the qualitative research found evidence that communities were already familiar with the use of SMS text messages as a means of disseminating information on health and nutrition topics. Viamo's 321 service was contracted to provide access to IVR recordings in order to cater

[43] Percent who agree they would trust information from each source.

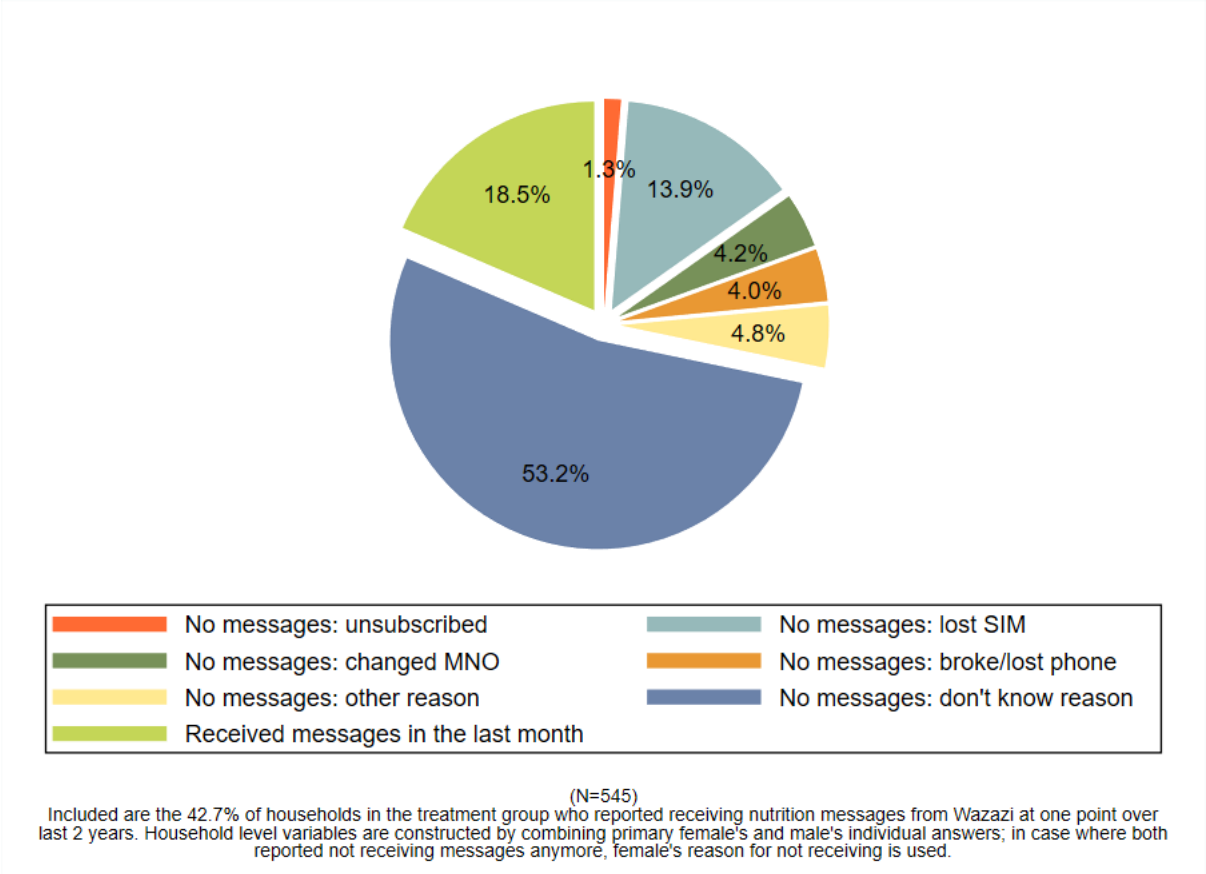
for those customers that struggle with written messages. The qualitative research identified a number of features of SMS messaging that fits well with women's lifestyles:

- text messages can be read repeatedly – audio messages may be heard incorrectly;
- as messages remain on the phone, they can be shared with friends and colleagues at any time; and
- text messages are private – they remain on the phone, which tends to be regarded as a personal device; audio messages can be overheard by others.

The quantitative study showed that household members in treatment households were overwhelmingly likely to read the mNutrition content they received on their phone, indicating that sending messages by SMS in Swahili is an effective channel. It should be noted that the SMS channel may be particularly well suited to the Tanzanian context, given that literacy levels are relatively high (for sub-Saharan Africa)[44], and the country is united by the language of Swahili.

In addition to these features, the quantitative study also found that users had a low attachment to their mobile phones (or their SIM, at least). Among people who were able to explain why they had not received messages (in the previous month), the largest single reason was that they had lost their SIM (see Figure 30).

Figure 30: Receipt of mNutrition messages in the last month, treatment group only



Source: Gilligan *et al.,* (forthcoming, 2020)

[44] The adult literacy rate in Tanzania is 78%, compared to an average for sub-Saharan Africa of 64% (2015 data from https://data.worldbank.org).

C.6 Customer relationships

The aims of the customer relationships that Wazazi Nipendeni creates with users can be considered to be threefold:

- Acquisition. Those who were assisted with registration have quite a different relationship with the service to those who self-registered. Their ongoing experience of the service depends not only on the content of messages, but also on whatever ongoing support and interaction they may continue to enjoy from the field agency. Registration data confirm the importance of field partners and the face-to-face interaction they provide in encouraging users to register for the service; up to 83% of users were signed up by partners (see Section 5.4).
- Retention. Several features of the system minimise pain points that might prompt users to leave a system. The service is free of charge so there is no need for any billing or payment processes, both of which can be tricky and cause customers to drop out of the service. Once a user's pregnancy or maternal status has been captured by the registration process, there is no need for the system to gather further information from users. Perhaps the most important factor is the perceived relevance and value of the content itself. Retention levels are high. Registration data indicate that the number of people opting out of the service is equivalent to roughly 7% of new users in a month. As the total number of active users grows, the attrition rate becomes increasingly small when expressed as a percentage of the number active users e.g. 0.5% at the end of a four-year period.
- Compliance. The service will achieve greatest impact if it can successfully persuade people to constructively change their behaviours. This depends on the perceived relevance and value of the content, and on the motivation of customers to comply with the messages they receive, which depends on the perceived trustworthiness of the content. High levels of satisfaction and perceived quality support high retention levels. Nearly 90% of those who self-reported having ever received the content read all messages received, and over 80% self-reported implementing at least one tip.

The study has not been able to generate any insights into the nature of the ongoing support provided by partners because locations for both quantitative and qualitative studies were selected on the basis of low registration levels (and no partner presence).

Wazazi Nipendeni has a strong brand, which is quite distinct from the MNOs that support the service, and users tend to view it as a MoHCDGEC service, as the Government pushed it through the media. Originally, Wazazi Nipendeni was branded a CDC action, but it is increasingly MoHCDGEC-branded as MoHCDGEC adopts more of the service. Users do not necessarily appreciate that the MNOs are paying for the messages.

Given that most of the funding for the mHealth Tanzania-PPP comes from CDC, it can be argued that the most important relationship is that with CDC. Providing evidence that the service is delivering improved health outcomes is important. Although commercial viability was a priority for FCDO in their original concept for the mNutrition programme, it is not clear that this is a similar priority for other donors and organisations that have supported the service over the years.

C.7 Revenue streams and indirect benefits

Wazazi Nipendeni is free of charge to users, so there is no direct revenue stream. The original mNutrition project design was based on the assumption that users would pay for information (e.g. via subscriptions) and that this would provide opportunities for participating organisations to develop commercially sustainable business models, even though nutrition information was to be

made available using a freemium model. However, late in 2016 the mHealth Tanzania-PPP and TFNC held intense negotiations over whether or not Wazazi Nipendeni would be permitted to charge for these information services. In the end, the Government insisted that health information should be made available to citizens free of charge.

The willingness of users to pay for health and nutrition information has yet to be tested. However, it is political pressure that is the main determinant of business models. Governments across many African countries have insisted that health-related information should be made available for free, as national policies state that health services should be made available for free at the point of delivery.

A key feature of the Wazazi Nipendeni service is that it has also been made available free of charge to field partner institutions running behaviour change interventions within Tanzania, so no direct revenue is generated from partner organisations.

The mHealth Tanzania-PPP is currently funded by CDC, although the successful functioning of the service depends on contributions by various partner organisations. The service is, therefore, vulnerable to any withdrawal of funding from CDC. Current funding is planned to 2020. The service also depends on the zero-rating of text messages by partner MNOs.

Phone numbers are used as the unique user identifier on the Rasello platform, so users can only register one number (although in principle they could self-register as many numbers as they like). Tanzania recently introduced mobile number portability (Tanzania Communications Regulatory Authority (TCRA), 2019) but it is unlikely that this is common practice. For example, even 10 years after number portability was introduced in South Africa, only 2.5% of the subscriber base port their number in a year[45] (Independent Communications Authority of South Africa, 2017). Registration data from Rasello indicate that drop-out rates are low, which also suggests that users are not readily changing their mobile numbers. The qualitative research found that most people use multiple SIMs, swapping them into their phone depending on which network has a signal and which offers the cheapest tariff, e.g. time of day, off-net tariffs, and bundle features. In the baseline report, it was proposed that the Wazazi Nipendeni VAS could offer MNOs indirect benefits associate with reduced churn. However, this has proven not to be the case. The quantitative study found no difference in the length of time that respondents reported having had their main SIM card (both groups had owned their primary SIM for just under three years, and their second SIM for just over two years), there was no difference in the likelihood that they had the same primary phone number as they had at baseline (a two-year duration), and there was no difference in the proportion who subscribed to the same operator as at baseline.

The baseline report also proposed that, as a VAS, Wazazi Nipendeni could lead to an increase in ARPU among users, and the quantitative study found that this has indeed been the case. Control households spent an average of TZS 5,300 per month (£1.90/month) on mobile phone airtime (including any data bundles), but spending was 10% higher (TZS 510, £0.18/month) in treatment communities. The qualitative study found that women using the Wazazi Nipendeni service became more confident in using their phones, which explains the increase in ARPU. They were more likely to make and receive calls, more likely to have sent and received text messages, more likely to have used mobile money services, and more likely to have used their phone intensively.[46]

The latest DHS data indicate that 53% of people (across the country) had heard of Wazazi Nipendeni (see Table 6). TCRA data for October 2018[47] give the total number of subscribers on

[45] Annualised porting rate is taken as the total cumulative ports, divided by the number of years since the service was launched.
[46] Used their mobile on most days during the past 14 days.
[47] www.tcra.go.tz/index.php/quarterly-telecommunications-statistics

the four partner networks as 41.0 million. Therefore, 550,000 Wazazi Nipendeni users represent 1.3% of the entire subscriber base. Given the reach and positive brand of Wazazi Nipendeni, it is surprising that the MNOs supporting Wazazi Nipendeni do not make greater use of their contribution and the Wazazi Nipendeni brand in their promotional materials.

It does appear that MNOs are beginning to recognise the political value attached to their support for Wazazi Nipendeni. In an unpredictable political environment in which the Government can potentially impose regulatory constraints (such as taxes), there is political capital to be gained by supporting a public good that plays a part in implementing the Government's health policy. By signing agreements to support Wazazi Nipendeni directly with the Government rather than with the mHealth Tanzania-PPP, MNOs are gaining recognition of the value of their contribution.

C.8 Key resources

Key resources are defined as those assets required to create and offer the value proposition. The primary assets employed by the mHealth Tanzania-PPP in delivering the text messaging service are the content database and the applications platform that sends scheduled messages.

The current content comprises the pre-existing database brought by the mHealth Tanzania-PPP, and additional content generated through the mNutrition programme. This nutrition content is regarded as a public good, having been paid for by FCDO. In March 2019, CABI made this content publicly available under open access through its Knowledge Bank resource.[48].

The text messaging service originally ran on the Vusion platform developed by TTCM in partnership with the Praekelt foundation. In October 2016 Wazazi Nipendeni migrated to a new platform, created for MoHCDGEC by a local software developer (Rasello). The new platform offers improved reliability as well as improved monitoring and reporting facilities. For example, the mHealth Tanzania-PPP has been able to equip MNOs with their own dashboard so they can track the number of users and messages being sent.

The text messaging service is designed to serve as part of multimedia campaigns, so the field partner programmes and interventions are a key resource required to deliver the full potential of the value proposition. To date, 24 partners have assisted with registering users in the field (see Section 5.9).

The key 'resource' in convening these partnerships has been, and will continue to be, the partnership with TFNC and its linkages to both national nutrition policymakers and health and nutrition interventions launching in the country. TFNC also acts as the moderator of health and nutrition content, bringing to the partnership its technical expertise in this area. The content localisation and approval process was acknowledged by stakeholders as going particularly smoothly as a result of having TFNC on board.

Early in 2019, the country manager at the mHealth Tanzania-PPP handed over to a new team leader. The country manager had been intimately involved in the development of the mHealth Tanzania-PPP for nearly 10 years. The interesting feature of the new appointment was that while the previous country manager came from a mobile technology background, the new team leader is a medical professional. This reflects the changing complexion of the PPP, as it continues to encourage Government agencies to take ownership of the platform itself, along with associated technical responsibilities. Strengthened health resources in the mHealth Tanzania-PPP leave it better able to engage with health policy issues and to broker partnerships with health sector actors.

[48] https://ckan.cabi.org/data/dataset/nutrition-knowledge-bank

C.9 Key activities

In order to make the business model work, perhaps the most fundamental activity that needs to be undertaken is networking. Both TFNC and the mHealth Tanzania-PPP clearly have good personal contacts in order to broker partnerships with field NGOs, and to enlist the support of MNOs. The strength of personalities is likely to become less important as MoHCDGEC assumes greater ownership of the technical platform and is able to integrate participation in the Wazazi Nipendeni system into processes required for health interventions to be implemented in country.

Under the original vision for the mHealth projects under the mNutrition programme, it was expected that content delivered by the Global Content Partnership would simply be made available to all partners participating in the mHealth service, and that each participating organisation would use their own resources to adapt the key messages to specifically match their target audience and to suit their own objectives. This was subject to an obligation (or expectation) that nutrition content would then be made available by participating organisations free of charge to users. The Global Content Partnership was, therefore, mandated to create higher-level, generic content, and little provision was made for creating specific, locally relevant messages. However, when the original 'clearing house' vision was abandoned, there was then a need for a new stream of work to create specific, locally relevant messages, in the local language, ready to be integrated into the existing Wazazi Nipendeni database of content. This was done by the partnership of Every1Mobile and COUNSENUTH. Detailed testing of mHealth content was never part of the original concept, as it was expected that local partners would do this for themselves, so additional funding was made available to cover end-user testing as part of the localisation process.

TFNC was the government agency responsible for signing off content at the end of the content generation process. However, TFNC adopted a much more proactive role, and its involvement has continued to deepen throughout the project. When the content generation process was changed to facilitate the production of more detailed, localised content, TFNC got more involved. TFNC's engagement with and awareness of the programme played an important role in ensuring that signing-off procedures went smoothly.

Monitoring and evaluation is a key activity, as evidence of the contribution that Wazazi Nipendeni makes towards positive health outcomes will be instrumental in negotiating partnerships with forthcoming health interventions. It is expected that the positive outcomes highlighted by this evaluation study will be of value to the mHealth Tanzania-PPP and to TFNC in this regard.

Providing a face-to-face presence when working with women is important, not only for assisting with registration onto the Wazazi Nipendeni system, but also for achieving positive behaviour change. The qualitative study confirmed that messages may play an important role in reinforcing and supporting the efforts of health workers. The study found that messages acted as reminders to reinforce information provided by health workers, and to reinforce mothers' existing knowledge. Note that even though people may trust information given by text messages (Figure 28), they are still most likely to get information from health workers (Figure 29).

The core business of delivering content to beneficiaries depends on the technical infrastructure that deals with registration, scheduling, and the dispatch of messages to users. This is sub-contracted to Rasello, as the platform provider, and management is being gradually transferred from the mHealth Tanzania-PPP to MoHCDGEC.

Content will need to be regularly updated to keep it relevant, e.g. new drugs and products will be introduced, and recommended practice will be modified. People will quickly lose trust in information

that is not immediately useful, or, even worse, wrong. Quality assurance processes for any revisions ought to be as rigorous as those adhered to during the mNutrition programme. It is not clear that any of the partners has the mandate or the funding to undertake this type of ongoing maintenance.

C.10 Key partnerships

The complex set of partnerships brokered by the mHealth Tanzania-PPP and TFNC is a defining feature of the Wazazi Nipendeni service. Partnerships have been crucial to accessing all the resources needed to make the service succeed:

- Research and design. Wazazi Nipendeni was originally conceived as a prevention of malaria in pregnancy campaign, following an analysis by JHCCP of the 2010 Tanzania DHS data. The mHealth Tanzania-PPP delivered the text messaging service as part of the campaign put together by JHCCP and MOHSW.
- Content. Content development for the SMS component of Wazazi Nipendeni was led by MOHSW, to ensure messages were developed in line with Government recommendations and delivered in line with timing guidelines provided by the World Health Organization (WHO). Further content was leveraged from the Mobile Alliance for Maternal Action.[49] Content on family planning was leveraged from Mobiles for Reproductive Health (m4RH).[50] Content for Prevention of Mother-to-Child Transmission was designed by EGPAF. TFNC was instrumental in securing the support of the SBCC TWG for nutrition in approving content.
- Technology platform. The service was originally run on the Vusion open source platform developed by TTCM. The system architecture led to problems with reliability, latency, and cost. The service was migrated to a new platform in October 2016. It was hosted locally by Rasello and was commissioned and paid for by MoHCDGEC (with CDC funding).
- Telecoms operators. The mHealth Tanzania-PPP had identified MNOs as key partners at the start. However, MNOs needed to be convinced of the viability of the concept before committing. The Wazazi Nipendeni campaign was launched without explicit support from MNOs, but after the service achieved 100,000 users within 11 weeks the MNOs entered into agreements.
- Field partners. The programme launched in November 2012 with a two-month nationwide media campaign (radio and TV). A follow-up campaign ran from July 2013 to February 2014, during which field partners promoted the service and assisted with registrations. In addition to the 24 field partners (see Table 9) that have formal agreements with the mHealth Tanzania-PPP (and have a source code allocated on the system), other agencies have simply incorporated registering women onto Wazazi Nipendeni into their field processes. Analysis of registration data suggests that field partners may have assisted up to 83% of users to register.
- Government agencies. The Government of Tanzania is committed to a number of relevant health policies on nutrition, sexual and reproductive health, and maternal mortality, and to a number of information and ICT policies, including open and accountable government, and electronic access to health services.

The network of key institutions is presented in Figure 2. The nature of the relationships covered by each category of partners is summarised in Table 8.

[49] A PPP, launched in May 2011 by USAID and Johnson & Johnson, with supporting partners, the United Nations Foundation, the mHealth Alliance, and BabyCenter.
[50] A pilot project led by Family Health International 360 with MOHSW and funded by USAID.

Table 8: What parties give and get from partnership relationships

Partnership	Contribution of parties		Type
	First set of partners	Second set of partners	
JHCCP/CDC/President's Malaria Initiative/PEPFAR–Wazazi Nipendeni	JHCCP/CDC/ President's Malaria Initiative/PEPFAR: funding, technical assistance	Wazazi Nipendeni: access to women, effective behaviour change communication channel	Donor
MOHSW – Wazazi Nipendeni	MOHSW: legitimacy, authorisation, content	Wazazi Nipendeni: help to deliver nutrition strategy, access to women, effective behaviour change communication channel	Partnership
CDC – Cardno	CDC: cash	Cardno: management expertise	Contractual
Wazazi Nipendeni – mass media campaign agencies	Wazazi Nipendeni: cash	Agencies: technical expertise	Contractual
Wazazi Nipendeni – mobile content partners	Wazazi Nipendeni: access to women, added value to existing content developed by partners	Partners: content, technical expertise	Partnership
Wazazi Nipendeni – tech providers	Wazazi Nipendeni: ICT deployment opportunity, project funding	Tech providers: technical expertise	Partnership
Wazazi Nipendeni – MNOs	Wazazi Nipendeni: indirect benefits (CSR, loyalty)	MNOs: free SMS	Partnership
Wazazi Nipendeni – implementation partners	Wazazi Nipendeni: access to women, effective behaviour change communication channel	Partners: field presence	Partnership

Notes: In this table, Wazazi Nipendeni is used synonymously with the mHealth Tanzania-PPP.

Source: Authors' own

Table 9: Field partners and registrations

Partner	Proportion of registered users
AFRICARE	0.0%
AFYA C4C	0.0%
Agri Team Health Tanzania	0.1%
AMREF	0.1%
BRN-MOH	0.0%
Comprehensive Community Based Rehabilitation in Tanzania (CCBRT)	1.7%
EGPAF	0.1%
HAPA	0.0%
HIP-Aga Khan	0.2%
HJFMRI	0.2%
HKI	0.0%
HKI-SMS	0.0%
IHI	0.4%
JHI	0.1%
JHPIEGO	0.0%
Moby	0.3%
NHIF	44.5%
Pathfinder	0.5%
PHARM ACCESS	0.2%
PSI	0.5%
SHDEPHA	0.0%
Toto Health	6.4%
United Nations Children's Fund (UNICEF)	1.0%
World Lung Foundation	0.2%
World Vision	0.0%
Total	56.5%

Source: Authors' own.

C.11 Costs and investment

The baseline report presented set-up and ongoing costs covering a two-year period, mainly derived from costs reported by the mHealth Tanzania-PPP and GSMA. Now that more detail has been provided, these costs have been superseded by a more comprehensive and rigorous analysis, which is presented in Section 7.

In addition to those costs directly associated with the mHealth Tanzania-PPP (both operating and capital), FCDO and GSMA have invested in wider programmatic costs that stimulated and supported this action. It is worth noting that the mHealth Tanzania-PPP has a history of donations and in-kind contributions made over the years by the CDC and programme partners.

Annex D Analysis of users

D.1 Overview

The mHealth Tanzania-PPP submitted Wazazi Nipendeni registration data from the Rasello platform to the authors. The query was performed on 27 March 2019. The dataset contains the following fields:

- unique ID (anonymised);
- source (means of registration, e.g. short code, API);
- partner (who registered the user);
- category of user (e.g. pregnant woman, mother with child);
- stage at registration (months or weeks, representing the stage of pregnancy or age of child);
- registration date;
- status (active or inactive); and
- opt-out date (for inactive accounts).

The data required considerable manipulation, primarily because when pregnant women reach term (and are assumed to give birth), the original record is flagged as inactive and a new record is created with a new category of mother with child. Given that most users are women who have given birth while registered as users, there were a large number of 'paired' records that needed to be reconciled and collated. The working dataset includes additional categories to reflect these hybrid classifications, e.g. PW=>MC represents a woman who registered when pregnant but has since given birth and has continued using the service as a mother with a child.

Registration via USSD and API was introduced to make the registration process faster and easier. Registration by API was initially introduced by NHIF in July 2016, then use of API as a registration source was adopted by other partners from 10 November 2016 onwards. Registration by USSD appears to have been introduced on 10 November 2016[51] and registrations were submitted by multiple partners. However, there is a spike in registrations on this date. 6,833 records were submitted on this date: 78% by USSD and 21% by API.

There appears to be a further anomaly in registrations completed by USSD in November 2018. There is a spike in the number of registrations completed by USSD during the three-week period form 4 November 2018 to 24 November 2018. Most of these have no associated partner. There are no further registrations by USSD after this date, which seems unlikely.

A 'working' dataset has been restricted to all records covering a two-year period between 11 November 2016 and 3 November 2018. The following numbers of records have been omitted:

- up to and including 10 November 2016 – 40,951; and
- 4 November 2018 onwards – 50,664.

The following steps were taken in the preparation of the dataset used in the analysis (and summarised in Table 10):

1. Data were submitted in four files, containing a total of 1,179,500 records.

[51] With the exception of 157 records submitted in the period August to September 2016.

2. Paired duplicates were collated, and ID errors were omitted from each file, leaving a total of 853,000 records.
3. Files were then merged and paired duplicates across years were collated, leaving a total of 744,000 records.
4. Records with various unresolvable data were omitted, leaving a total of 739,100 records. Omitted records included those with '#VALUE' in the Registration date field, 'NULL' in the Source field, outliers in the Stage field, and records with an opt-out date as well as an 'Active' Status.
5. Migrated accounts (from the Vusion system) were omitted. Staff at the mHealth Tanzania-PPP reported that porting data from the old to the new system was fraught with difficulties, resulting in inconsistencies in the data on the new platform. For example, 62% of migrated data records contained a single registration date (16 November 2016, which corresponds roughly to the date the migration took place). All 88,100 migrated records have been omitted.
6. Anomalies in November 2016 and November 2018 cast doubt over the integrity of data before and after these dates, so only data from the intervening two-year period has been used.

Table 10: Preparation of registration data for analysis

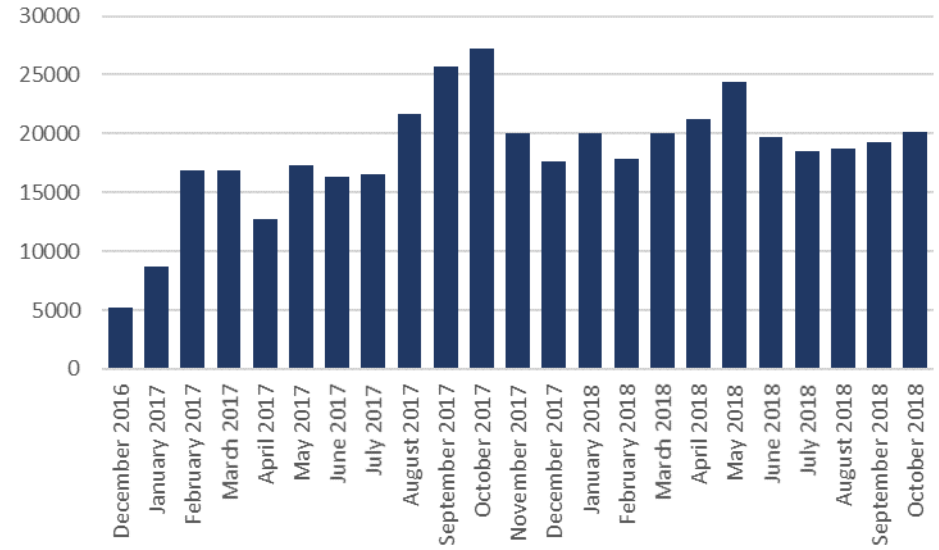
Step	Description	Records	% reduction
1	Data were submitted in four files	1,179,500	n/a
2	Pairing and errors omitted	853,000	n/a
3	Pairing across years	744,000	n/a
4	Cleaning	739,100	0.66%
5	Migrated accounts omitted	607,100	17.9%
6	Isolate two years (11 November 2016 to 3 November 2018)	515,500	15.1%

Source: Authors' own

D.2 Growth in user numbers

New registrations fluctuate monthly, as shown in Figure 31, and opt-outs fluctuate, as shown in Figure 33. In the period May 2017 – October 2018 new registrations were running at an average of around 20,000/month, whereas people were leaving the service at a much lower rate of less than 1,400/month, i.e. 7% of new users. Combining new users with people leaving the service gives the cumulative profile of active users presented in Figure 34.

Figure 31: Monthly registrations

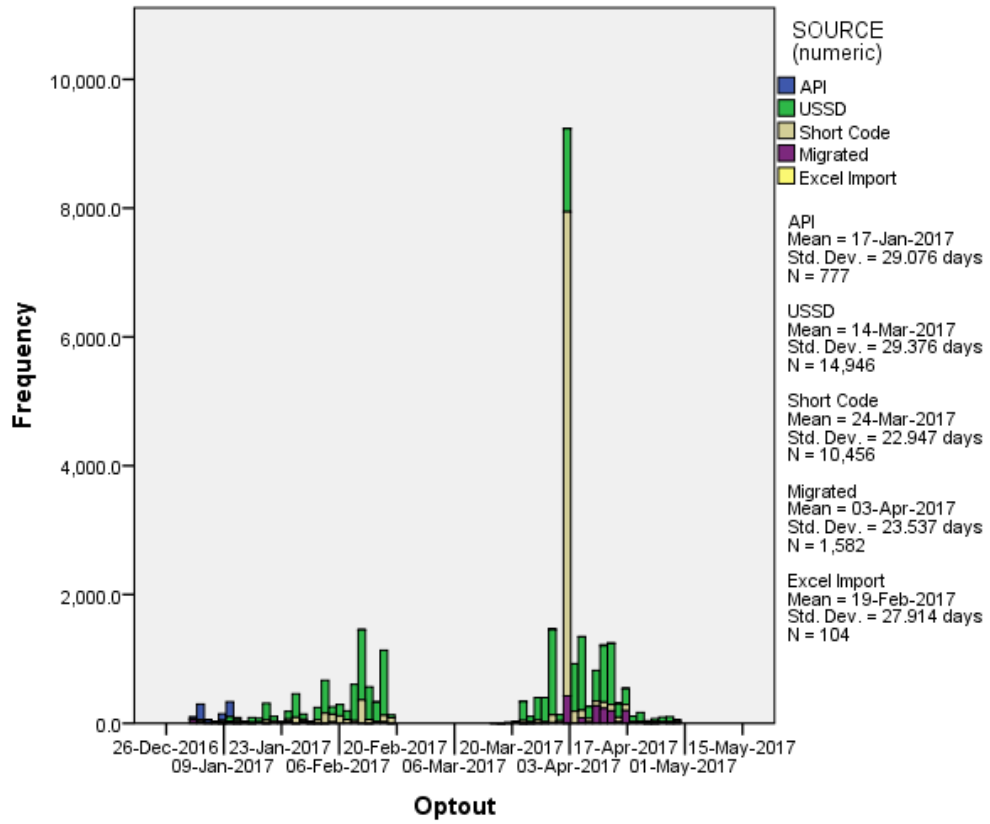


Source: Authors

As with registration dates, there were anomalies with the opt-out dates (see Figure 32). There was a spike in opt-outs on a single day: over 9,000 records were marked as having opted out on 3 April 2017. The majority of these had been registered using the short code (86%). Secondly, there was a one-month gap in which no opt-outs were recorded (mid-February – mid-March 2017). Therefore, only opt-out data from May 2017 onwards have been considered reliable and are presented in Figure 33.

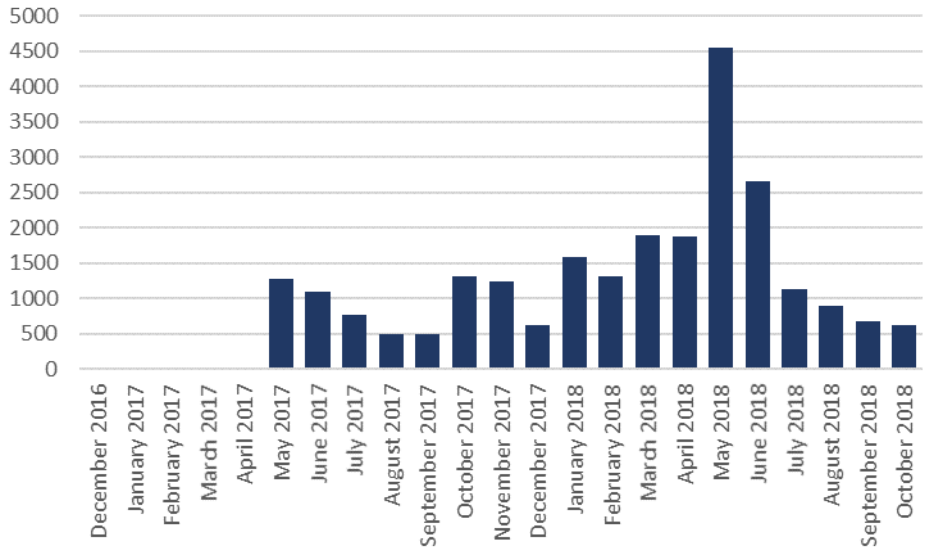
Note that the rate at which users opted out of the system was an order of magnitude lower than the rate at which they were being registered, so missing opt-out data has minimal effect on the trend of calculated active users presented in Figure 34.

Figure 32: Anomalies in opt-out dates



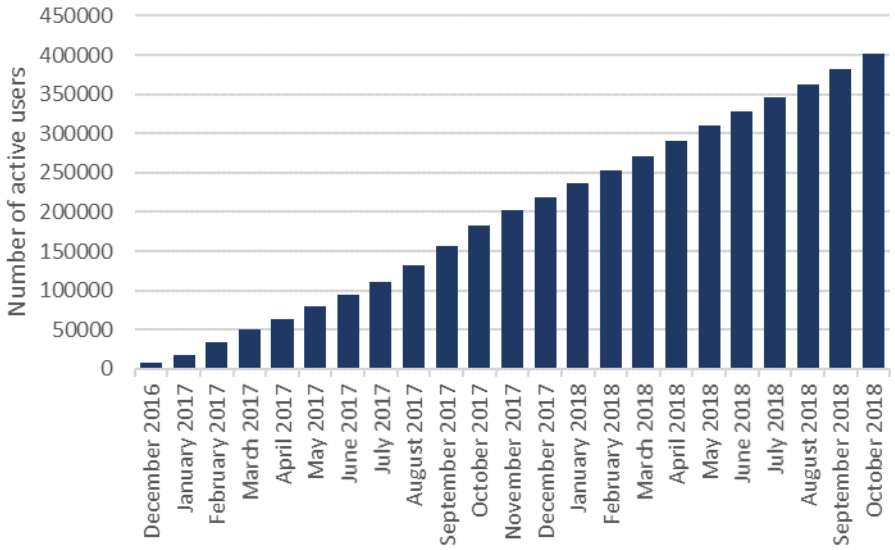
Source: Authors

Figure 33: Monthly opt-outs



Source: Authors

Figure 34: Growth in active users



Source: Authors

In the absence of reliable data, it is not possible to track patterns of growth in users from the introduction of the service. The total number of users may be up to 130,000 higher than these figures indicate, because many of the original users that were migrated onto the new system have not been included in these numbers (step 4 to step 5 in Table 10). Nevertheless, the patterns of growth and opt-outs remain accurate.

In November 2017, the mHealth Tanzania-PPP estimated the number of active users to be 350,000. This is consistent with the active user numbers in Figure 34, as adding 130,000 to the November 2017 estimate of 200,000 from the chart gives a total of 330,000, which is close to the mHealth Tanzania-PPP estimate. Making an assumption of straight-line growth in active user numbers, and assuming a starting base of 100,000 active users (rounded down), the number of active users after a two-year period (December 2016 to November 2018) is estimated at 550,000. This figure was validated by the mHealth Tanzania-PPP.

In their study of all eight health services in the mNutrition programme (GSMA, 2018), GSMA presents a chart of the total number of users reached from October 2015 to December 2017. In this chart, Wazazi Nipendeni users start from a base of zero in January 2016, rising to 770,000 in December 2017. However, these figures cannot be compared with the figures above because they represent the cumulative number of users reached.

D.3 Understanding users

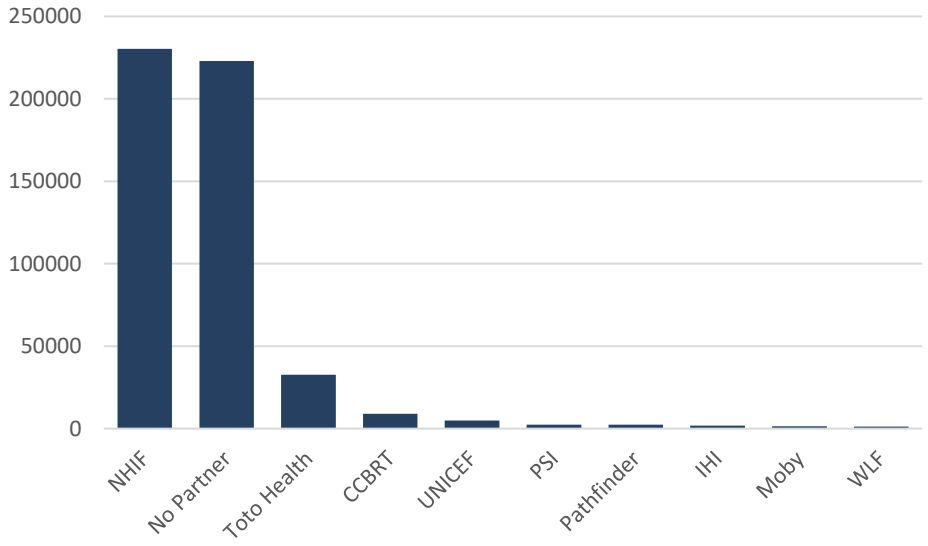
The NHIF has brought the largest number of users onto the system (Figure 35). This figure also shows that, to date, other partners have assisted few users to register relative to the number who appear to have self-registered (no partner).

Among the 11 partners that registered more than 1,000 users, all apart from UNICEF used either API or USSD exclusively (almost) – see Table 11. None used the short code. When the USSD system was introduced, SMS remained the channel the general public could use to register, but healthcare partners moved to using USSD. The USSD facility makes the registration process smoother because it can validate healthcare registration numbers in real time, so it can check if people enter incorrect registration data. When looking at users registered with no partner, 62% were registered using an API or USSD (Figure 36), suggesting that many could well have been

registered with the assistance of a field partner. It was reported that many women would have been signed up with the assistance of health workers when they visited clinics. It is not, therefore, possible to determine how many users truly self-registered, i.e. without any assistance. It is possible that up to 83% of all users could have been registered with the assistance of some kind of partner (official partner, or health workers), if API and USSD registrations were included.

An inherent difficulty with USSD sessions was that in areas with poor network coverage, the connection would be dropped before the registration process could be completed. It was reported that some partners resorted to using short codes, although this is not evident in the data from the period represented in Table 11. The USSD protocol was subsequently changed so that it was able to resume the session automatically. This was a concern as most of the marketing materials for Wazazi Nipendeni were based on the USSD functionality.

Figure 35: Registrations by partner



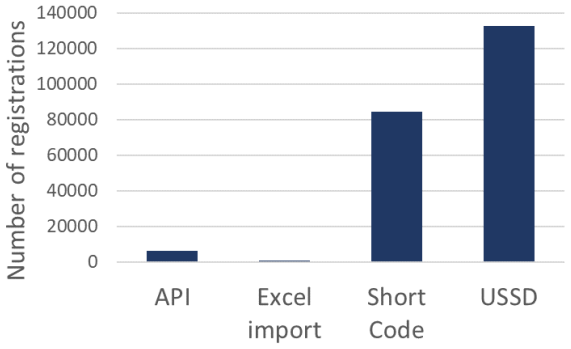
Source: Authors

Table 11: Sources used by partners to register users (top 11)

Partner	API	Excel import	Short code	USSD	Total
NHIF	229,247	0	0	0	229,247
Toto Health	9	0	0	32,744	32,753
CCBRT	0	0	0	8,986	8,986
UNICEF	0	4,898	0	99	4,997
PSI	2,398	0	0	0	2,398
Pathfinder	7	0	0	2,369	2,376
IHI	1	0	0	1,844	1,845
Moby	1,435	0	0	0	1,435
World Lung Foundation	0	0	0	1,269	1,269
HJFMRI	1	0	0	1,252	1,253
PHARM ACCESS	8	0	0	1,217	1,225

Source: Authors' own

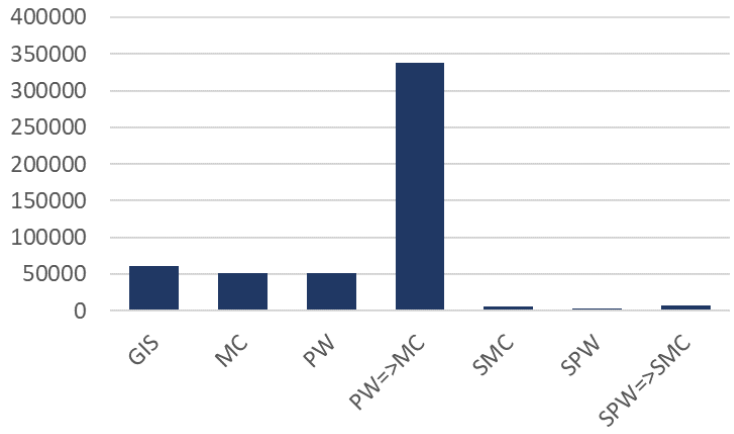
Figure 36: Sources used for self-registration (no partner)



Source: Authors

The majority of users (75%) were signed up as pregnant women (sum of 'PW' and 'PW=>MC' categories in Figure 37). 12% were general information-seekers, and 3% were supporters of one type or another. However, data in Table 12 indicate that by the end of the two-year period, all of the general information-seekers and most of the supporters had opted out of the system.

Figure 37: Categories of users registered



Source: Authors

Table 12: Proportion of registered users no longer active after two years

User	Proportion not active
General information-seekers	100%
MC	6%
PW=>MC	0%
SMC	100%
SPW	78%
SPW=>SMC	84%

Source: Authors' own

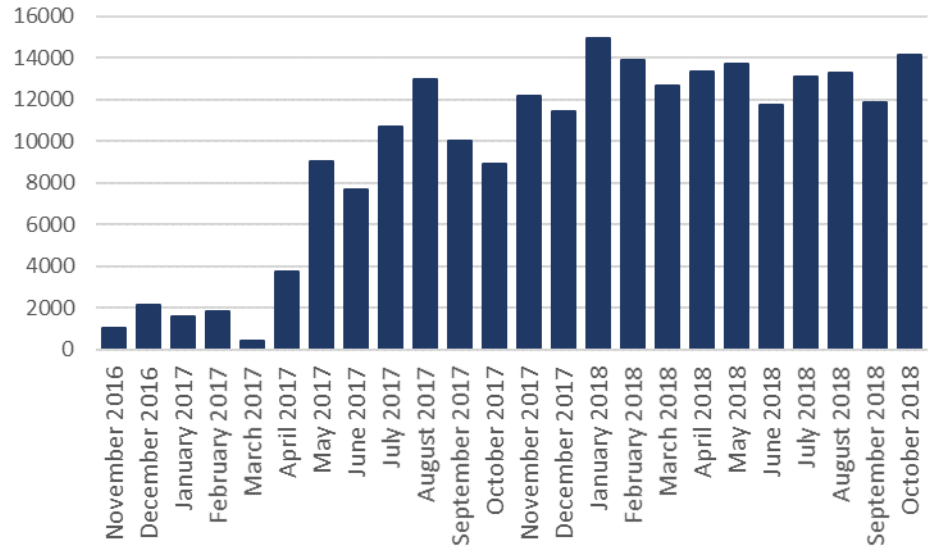
D.4 Partner programmes

Registration data provide some insights into the ways in which different programmes work. For example, the NHIF brings the largest number of people onto the system (see Figure 35), and Figure 38 shows that since numbers picked up in May 2017, the rate of registrations has been roughly constant. This is in contrast with self-registrations, the second largest source of

registrations, which fluctuate widely as people respond to local and national campaigns (see Figure 39). Although Toto Health is a partner that continues to bring small numbers of users onto the system, Figure 40 shows the impact on registrations of what appears to be a nine-month programme in the field.

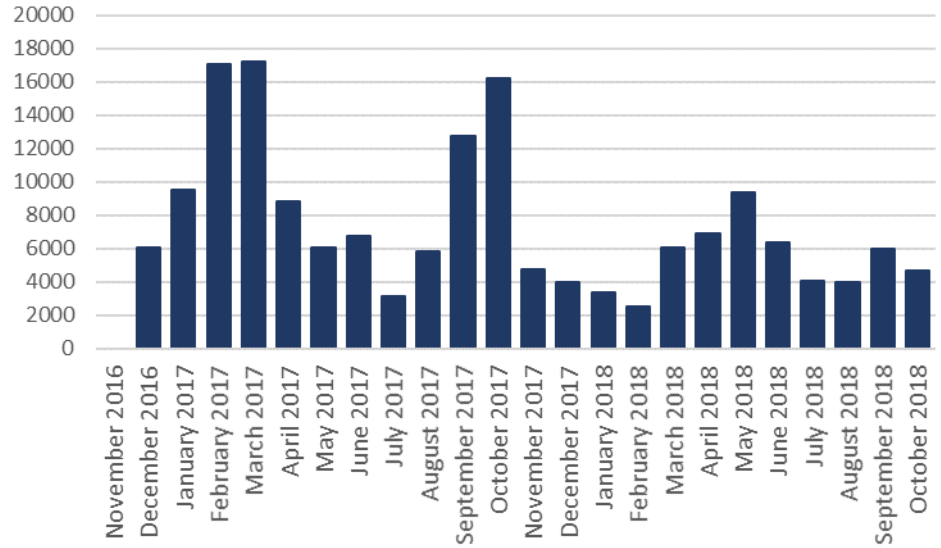
NHIF ran a pilot project in 5 regions of the country. They went from facility to facility to sign up women for a free health insurance scheme. NHIF normally charge premiums, but this was a special programme subsidised by a donor, so insurance was made free to consumers in the pilot. The pilot was completed at the end of 2018. It was regarded as a success, so a follow up phase was planned 4 months ago, which is currently waiting for the government to sign.

Figure 38: Monthly registrations – NHIF



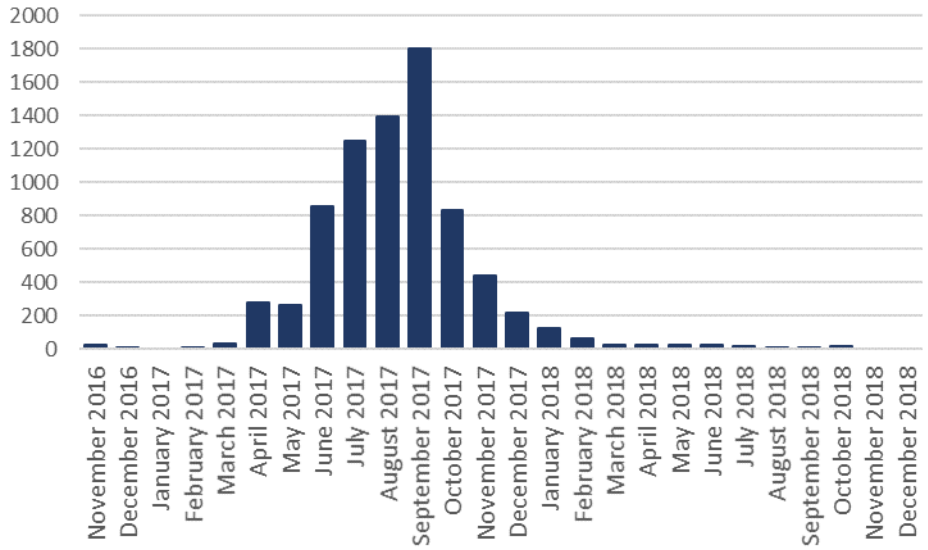
Source: Authors

Figure 39: Monthly self-registrations (no partner)



Source: Authors

Figure 40: Monthly registrations – Toto Health



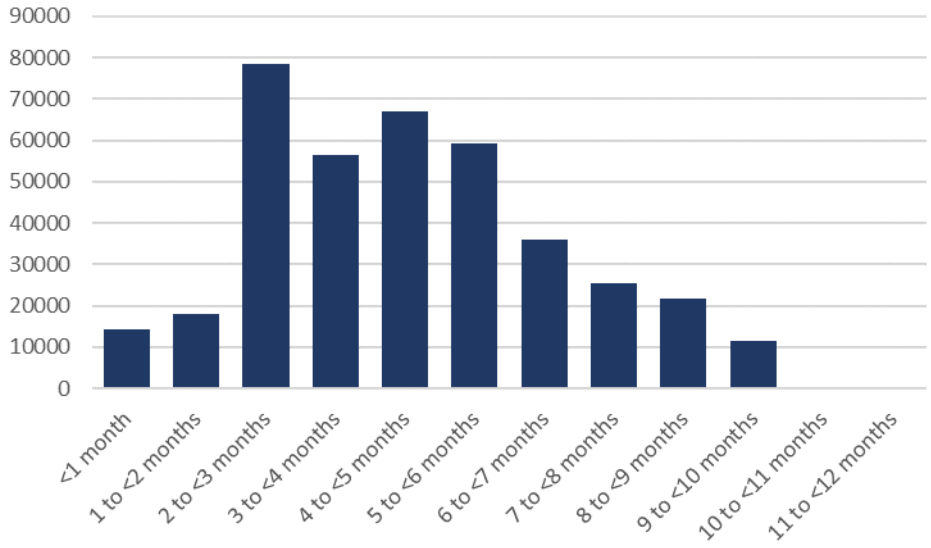
Source: Authors

D.5 Stage at registration

As part of the registration process, users were asked what stage of the pregnancy a women was at (in months or weeks). For mothers (and supporters), they were asked for the age of the child. Figure 41 shows that there was a peak in registrations of pregnant women at the three-month mark, which coincides with the first trimester of pregnancy. Note the small number of women registering in the 10th month of their pregnancy: this mostly likely represents women who were registered at or around the time they gave birth. Users who were supporting pregnant women also tended to sign up at the end of the first trimester (see Figure 42).

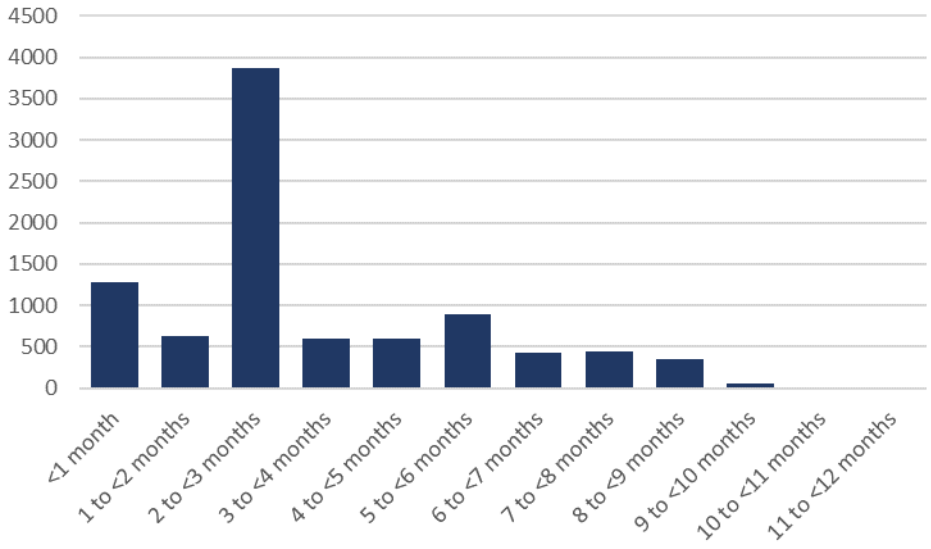
Users have been separated out into those who were registered by one of the partners listed in Table 9, and those who apparently self-registered. Section 6.3 analyses those users with no partner and suggests that, in fact, it is likely that most of them were assisted by some kind of health worker. The spike in registrations at the three-month point is most acute among these users (see Figure 43). This figure also shows that partners tended to register women later, from three to six months into their pregnancies.

Figure 41: Stage at registration – pregnant women



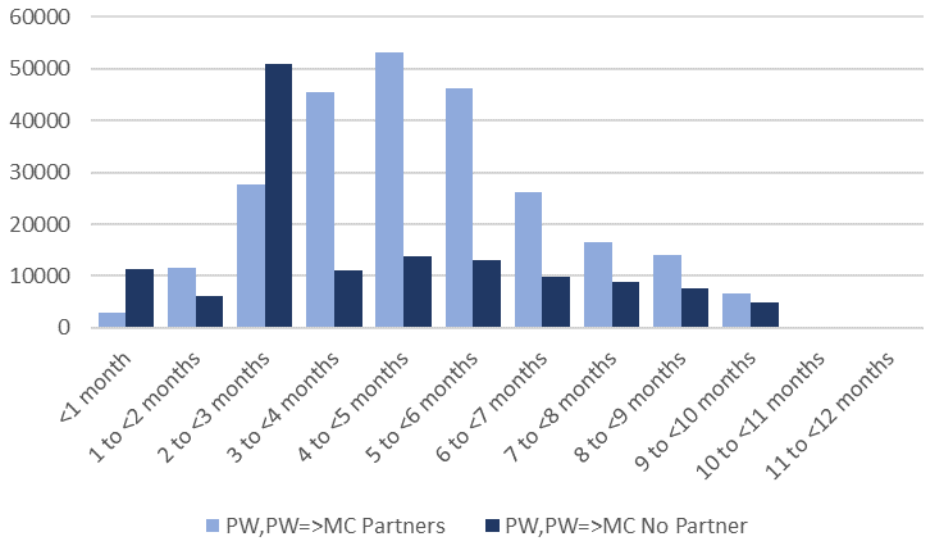
Source: Authors

Figure 42: Stage at registration – supporters of pregnant women



Source: Authors

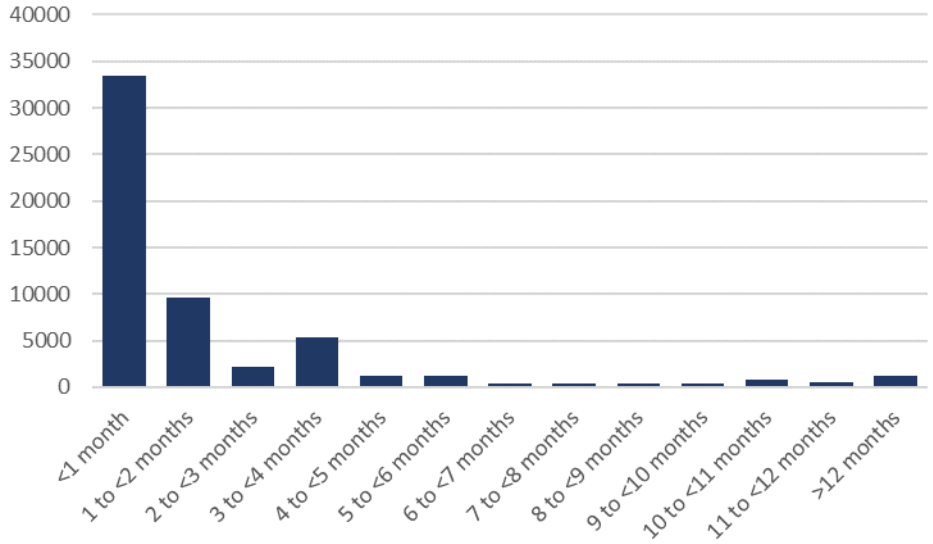
Figure 43: Stage at registration – pregnant women (partner and no partner)



Source: Authors

Users who registered as mothers (and supporters of mothers) mostly signed up within the first month of having a newborn (see Figure 44).

Figure 44: Age of child at registration (mothers and supporters)



Source: Authors

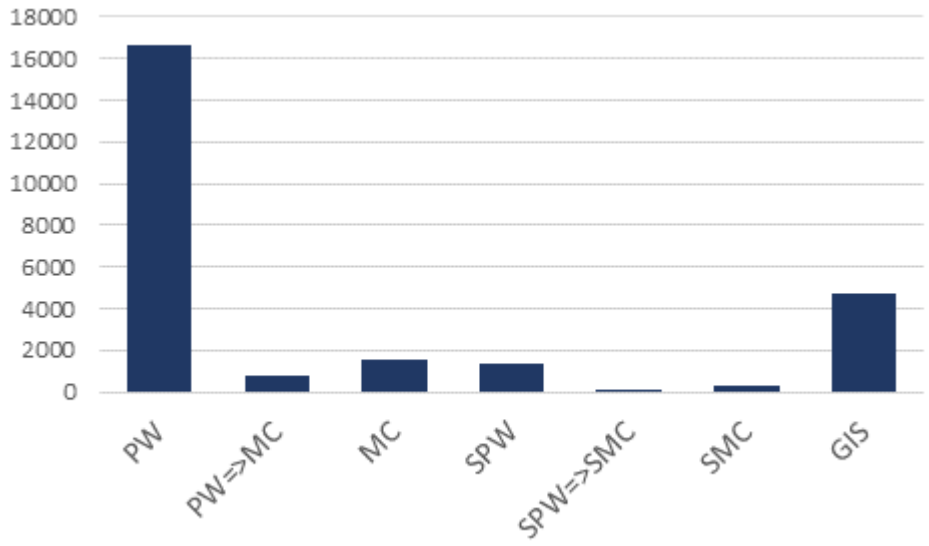
D.6 Duration of use of service

Given the relatively low level of people opting out of the service, the sub-set of data that represents users who have registered and then left the service is relatively small (n = 25,300). Remember that the addition of nutrition messages means that users remain registered until the child reaches the age of five years, so even children registered early in 2016 have not yet reached the age at which they will be automatically removed from the system. In principle, users can opt out of the service by

sending the word ‘Simama’ to the same number used for self-registrations. In practice, many users may not be aware of this.

Figure 45 shows that most users leaving the system were registered as pregnant women, and that they left before giving birth. The relatively low number of women in the ‘PW=>MC’ category suggests that women who used the system throughout their pregnancy liked it, and then continued to use it in motherhood. Note that this analysis omits a large number of users (61,000) who registered as general information-seekers (GIS), but for whom there are no valid opt-out dates.

Figure 45: Categories of users leaving the system (with valid opt-out dates)



Source: Authors

TFNC hypothesised that women who were assisted with registration might have a stronger commitment to the service, stay on the service for longer, be more likely to read the messages, and be more likely to adopt improved behaviours. Although it has not been possible to explore links between categories of users and outcomes, Table 13 sheds some light on the number of users leaving the service. This shows that of the 290,000 users who were registered by a partner, 80% were registered using an API and 18% using the USSD number. While 12% of those registered by USSD subsequently dropped out, only 0.3% of API registrations opted out. Among those users with no partner, 59% were registered by USSD, and may have been genuinely self-registered, or they may have been assisted by a health worker. However, only the general public continued to register using the short code, so 38% of those with no partner can be classified as self-registered with some confidence. 42% of these users opted out, which provides some evidence to support the TFNC hypothesis.

Table 13: Registrations and opt-outs; assisted and self-registrations

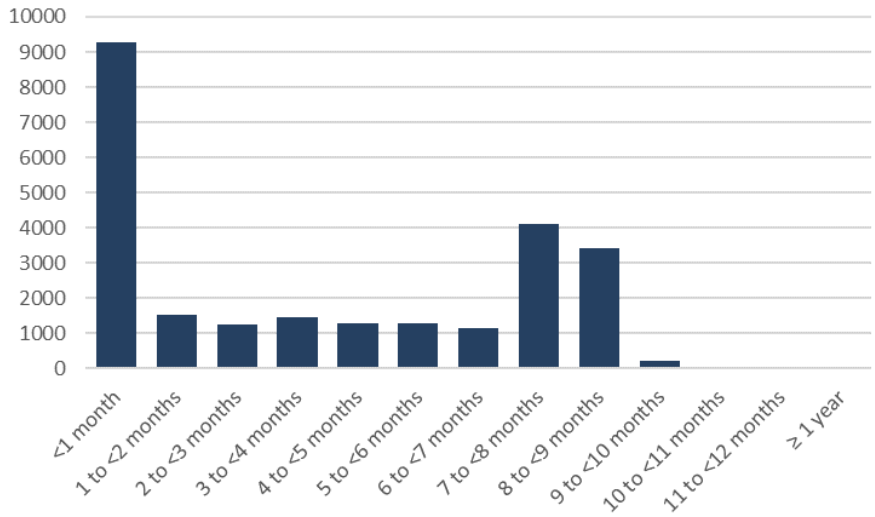
	Source (for registration)				
	API	Excel import	Short code	USSD	Total
No partner					
Number registered (all)	6,508	973	84,257	132,431	224,169
% of total registrations	2.9%	0.4%	37.6%	59.1%	100.0%
Number opted out	1232	105	35132	42688	79157
% of total who have opted out	1.6%	0.1%	44.4%	53.9%	100.0%
% of source who have opted out	18.9%	10.8%	41.7%	32.2%	35.3%
Registered by partner					
Number registered (all)	233,364	4,898	0	53,062	291,324
% of total registrations	80.1%	1.7%	0.0%	18.2%	100.0%
Number opted out	796	27	0	6204	7027
% of total who have opted out	11.3%	0.4%	0.0%	88.3%	100.0%
% of source who have opted out	**0.3%**	**0.6%**	**0.0%**	**11.7%**	**2.4%**

Notes: Number opted out is based on records with a valid opt-out date (not necessarily from May 2017 onwards).

Source: Authors' own

The majority of users drop out of the system within a month of registering (Figure 46). It is likely that this represents people who try the system and, for whatever reason, decide they do not like it and opt out straightaway. The second peak occurs after around eight months' use of the service. Given that most users register around three to six months into their pregnancy (Figure 41), this peak corresponds to when their child is aged around two to five months old. The reason for this peak is less obvious, but may represent mothers who found the service useful during their pregnancy, but not useful for helping with their newborn, so after persisting with it for a few months of motherhood they then decided to opt out.

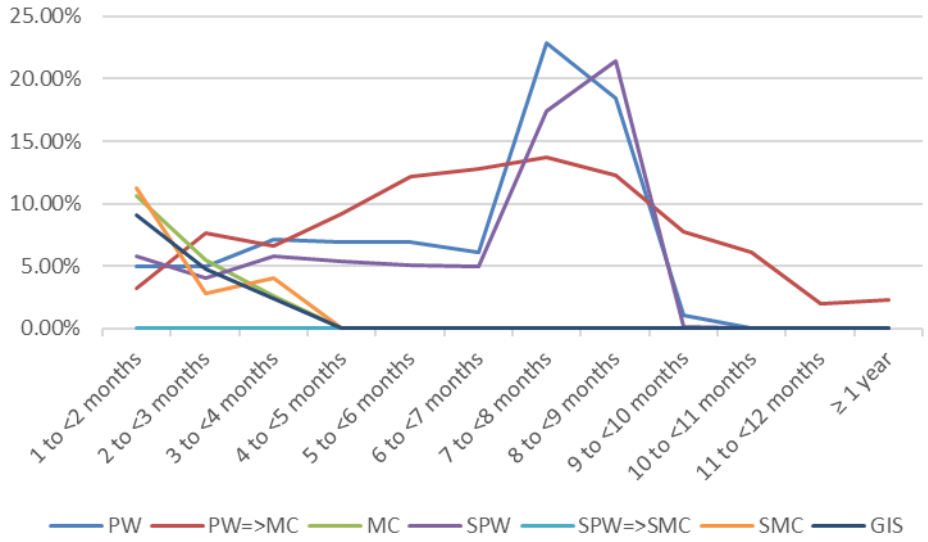
Figure 46: Duration in system (users who have opted out)



Source: Authors

For all categories of users, the peak period for leaving the system is within one month. If this period is omitted, and the number of users opting out in a given period is expressed as a proportion of the total number of users opting out for each category, then different patterns can be seen for different categories of user (Figure 47). The second peak for pregnant women and supporters of pregnant women occurs after seven months. The distribution of duration of use of the system among women who gave birth while using the system is much smoother. Mothers, supporters, and general information-seekers leaving the system had all done so within four months.

Figure 47: Duration in system by categories (users who have opted out)



Source: Authors

Annex E Cost data utilised for the financial model

Capital expenditure

Table 14 Capital cost items

Item	Estimate (£)	Source	Description
Country-level investment			
Localisation of content	62,500	CABI budget	All local content partner payments allocated to Tanzania (62,468)
Staff costs (Global Content Partnership)	20,000	CABI budget	All GAIN staff costs allocated to Tanzania (20,303)
Direct costs	0	CABI budget	All GAIN direct costs allocated to Tanzania (0)
mNutrition programme (country-specific)			
Product development			
Formative evaluation (International)	100,000	GSMA communications	See average country breakdown below
UX expert and design consultants	130,000	GSMA communications	See average country breakdown below
mNutrition programme (global)			
Global content development			
Global content partners	250,000	CABI budget	255,910 (per country programme)
Programme management			
Business intelligence and programme management (GSMA)	480,000	GSMA communications	See average country breakdown below

Source: Authors' own

GSMA mHealth total project budget average per country[52]: £1,055,900.

Breakdown of above cost per country (using Tanzania specifics where available):

- monitoring and evaluation/business intelligence £106,200
- UX £133,900
- global content £255,900 (from CABI budget for CABI GCP costs)
- local content £82,800 (from CABI budget for Tanzania)

Remainder covers GSMA contributions to business intelligence and programme management: £477,000.

Operational expenditure

The following estimates are based on data supplied by Cardno.

[52] Personal communication.

Table 15 Operational expenditure items

Item	Estimate (GBP)	Unit	Source	Description
Fixed costs				
Product development				
Content curation (local content partner)	34,000	£/year (after launch)		Lump sum estimate for keeping content up to date.
Marketing expenses				
Marketing events	0	£/qtr		No provision is made for direct marketing expenditures, as marketing is now done mostly by partner organisations through face-to-face contact and campaigns that are part of other field programme activities i.e. cannot be allocated directly to Wazazi Nipendeni.
Administration expenses				
Salaries and wages	65,000	£/qtr	Cardno communication	Assume 50% effort dedicated to Wazazi Nipendeni ($55,784/mth)
Fringe benefits	60,000	£/qtr	Cardno communication	Assume 50% effort dedicated to Wazazi Nipendeni ($51,777/mth)
Equipment	0	£/qtr	Cardno communication	0
Supplies	2,000	£/qtr	Cardno communication	Assume 50% expenses dedicated to Wazazi Nipendeni ($1,693/mth)
Contractual (Rasello)	82,500	£/qtr	Cardno communication	Assume 50% expenses dedicated to Wazazi Nipendeni ($71,267/mth)
Travel	1,750	£/qtr	Cardno communication	Assume 50% expenses dedicated to Wazazi Nipendeni ($1,442/mth)
Other	4,000	£/qtr	Cardno communication	Assume 50% expenses dedicated to Wazazi Nipendeni ($3,340/mth)
Government institutions	7,700	£/qtr	Cardno communication	Estimate of staff time ($3,333/month)
NGO partners (training and development)	23,000	£/qtr	Cardno communication	($9,918/mth)
Variable costs (cost of sales)				
Cost of SMS	57.6 (Vodacom)	TZS/SMS	mHealth Tanzania-PPP report	SMS market prices
Cost of SMS	69 (Airtel)	TZS/SMS	mHealth Tanzania-PPP report	SMS market prices
Cost of SMS	79 (Tigo)	TZS/SMS	mHealth Tanzania-PPP report	SMS market prices
Cost of SMS	33 (Halotel)	TZS/SMS	Website	Prevailing market rate for individual customers
USSD sessions	120	TZS/ session	mHealth Tanzania-PPP report	Single price attributed to all MNOs

Source: Authors' own

N.B. the price of SMS messages sent is the subject of debate in Section 7.3. The analysis of business models starts using retail prices (as claimed by MNOs) in Section 7.3 (Public Good model). After discussing the SMS price issue, it then shifts to using a more realistic bulk purchase price in Section 7.4. Then in Section 7.5 the price is dropped to zero, on the basis that this is closer to the real cost to an MNO.

The mHealth Tanzania-PPP provides a range of mobile health services in addition to Wazazi Nipendeni:

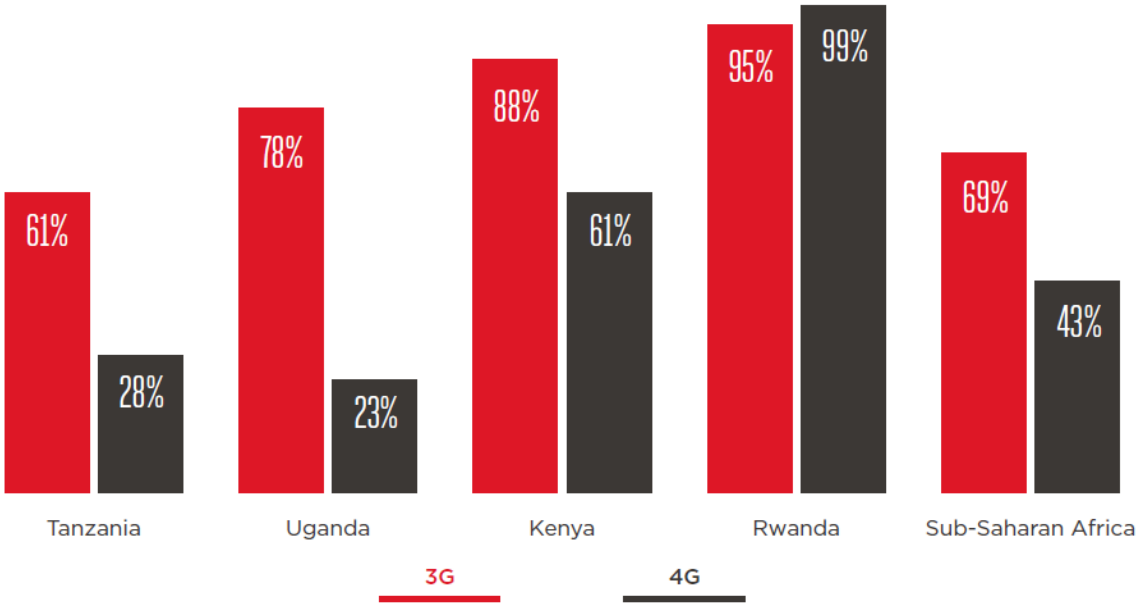
- TAMBUA TB apps for NTLP;
- Electronic Integrated Disease Surveillance and Response;
- National Blood Transfusion Text Messaging Service;
- National Feedback Mechanism for health services;
- Early Infant Diagnosis System (HIV); and
- NACP FASTA.

Therefore, the total costs for running the mHealth Tanzania-PPP need to be apportioned. In terms of expenditure, Wazazi Nipendeni accounts for over half of the money as it has higher recurring costs (it sends the highest number of messages). However, in terms of employee time, given that Wazazi Nipendeni is set up and established, staff effort is currently split roughly 40% on Wazazi Nipendeni and 60% on other programmes that they are getting off the ground, especially TB Tambua and FASTA TZ, and this has been the case for the last 2 years. The mHealth Tanzania-PPP has validated allocating an estimated 50% of costs to Wazazi Nipendeni as reasonable.

Annex F Technology and mobile business models

The majority of mobile internet connections are 2G, and Tanzania's broadband coverage lags behind its neighbours (see Figure 48). This can be interpreted as meaning that mobile data use is set to grow.

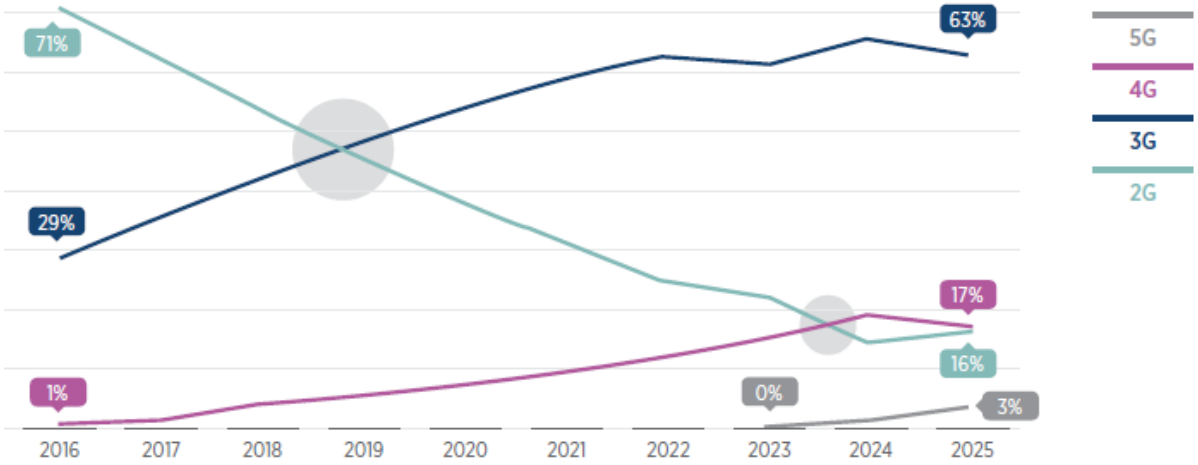
Figure 48: 3G and 4G coverage as % of population (2018)



Source: Okeleke, (2019)

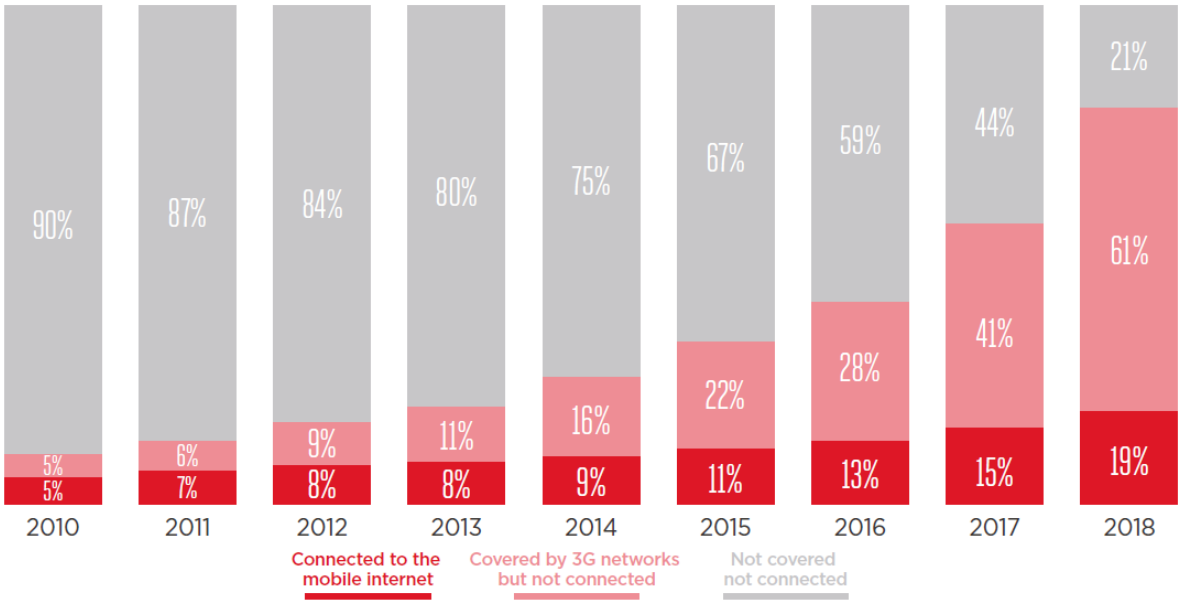
GSMA predicts that mobile data consumption across sub-Saharan Africa will multiply sevenfold by 2024 (from 1.1 to 8.5 GB/subscriber/month) (GSMA, 2019). Although 4G is growing and there is a good deal of excitement about 5G, 3G internet connections are likely to remain the dominant technology for the medium-term future (Figure 49). Indeed, Figure 50 shows the rapid increase over recent years in 3G coverage in Tanzania.

Figure 49: Breakdown of mobile internet connections by technology



Source: GSMA, (2019)

Figure 50: Connected and unconnected populations in Tanzania



Source: Okeleke, (2019).

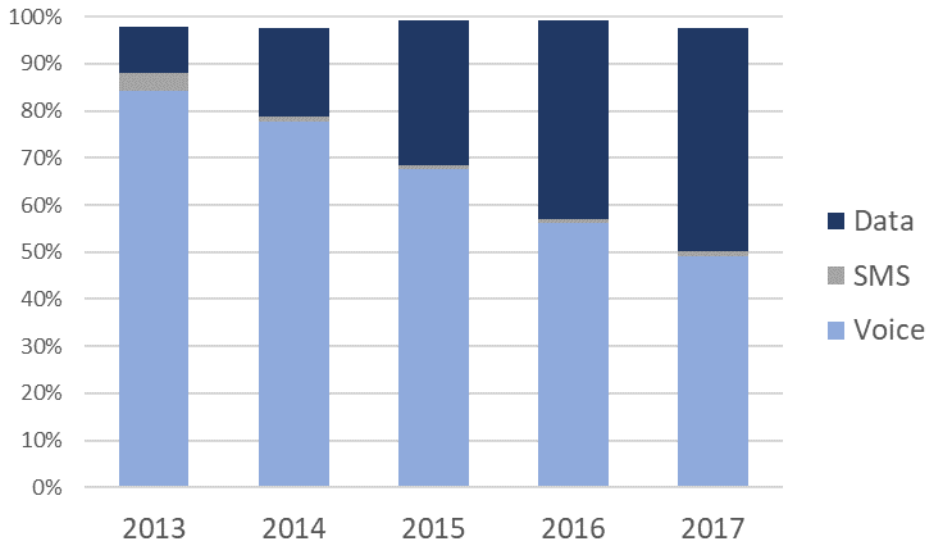
The influence of over the top (OTT) services continues to grow. In 2017, 20% of adults in Tanzania used social networking sites such as Facebook and Twitter (Pew Research Center, 2018). Use has grown by one-third over the three years from 2014 to 2017.

Esselaar and Stork (2018) argue that with data-driven business models, increased revenue from data services can more than make up for any decline in voice revenue from OTT services. They present financial data from MTN Ghana as an example of a data-centric business model. Figure 51 shows how data have generated an increasing share of total revenue, to the point where they are likely to generate more revenue than traditional voice and SMS.

Entertainment services drive a good deal of growth in data use. As TVs become more widespread (e.g. demand for solar home systems is often driven by affordable Light Emitting Diode televisions), the affluent are spending more time watching TV and video on mobile devices.[53] This trend in increased TV and video access is an important feature of the changing media landscape in sub-Saharan Africa countries, and may well have implications for public health communication strategies.

[53] www.ipsos.com/en/how-digital-driving-media-growth-africa

Figure 51: Breakdown of revenue by service (MTN Ghana)



Source: Authors' own, based on Esselaar and Stork, (2018)

Smartphone ownership is a key barrier to extending access to mobile internet services. In Tanzania, smartphone ownership stood at around 13% of adults in 2017, well below the median for sub-Saharan Africa (33%) (Pew Research Center, 2018). Smartphone sales are on the rise, and GSMA estimates that the number of handsets will more than double from 2018 to 2025. Adoption of smartphones in remote rural areas is likely to be relatively slow, not only because of poor data network coverage, but also because of the relatively poor battery life offered by cheap smartphones. Pew research shows that although only 13% of adults had smartphones, 25% were using the internet (note that TCRA data suggest the proportion of internet users may be higher, although it does not attempt to identify unique users). This indicates that people find alternative means of accessing the internet, e.g. free Wi-Fi hotspots, and some feature phones can support internet-enabled services. Nevertheless, the falling price of smartphones will continue to strengthen access to data services: for example, MTN has ambitious plans to sell a $20 'smart feature' phone that uses the KaiOS operating system to create a smartphone user experience providing access to Google and social media apps.[54]

Data services will be instrumental in overcoming literacy barriers, as well as providing a richer information dissemination experience (e.g. audio and video). It is likely, therefore, that the reach and efficacy of mobile health services targeting the poorest will improve once they can be delivered via smartphones. However, poor network coverage means that this is unlikely to be the case within the medium-term future and, in the meantime, voice-based features (e.g. IVR, outbound dialling, call centre) are likely to be the most effective media for engaging with remote and low income communities.

In a mature market, in which almost all potential subscribers are signed up with one MNO or another, the strategy of VAS is to encourage subscribers on other networks to transfer (churn), and to encourage network subscribers to stay with the MNO that provides a valuable service, rather than switch to competing networks. This applies to most VAS, but not necessarily to Wazazi Nipendeni, as it is available on all of the major networks in Tanzania. The Wazazi Nipendeni service would not, therefore, provide any incentive for a customer to switch network, but it might well encourage them to stay with their current provider.

[54] www.businesslive.co.za/bd/companies/telecoms-and-technology/2018-11-14-mtn-to-offer-entry-level-smartphones-costing-20/

Perhaps the most transformational technology that has blossomed since the baseline report is mobile money. In 2017, 60% of the population had a mobile money account (Okeleke, 2019), and TCRA figures show a 40% increase in accounts over a three-year period from 2016 to 2019. M-Pesa (Vodacom) is the market leader in Tanzania, at 40% market share, and Tigo Pesa is second, at 32%. Okeleke (2019) estimates that the value of transactions processed through mobile money services in 2017 was $22 billion, equivalent to almost half of the country's GDP.

Annex G Technology mHealth innovations

The Health Data Collaborative[55] has done some interesting work on classifying digital health interventions, led by the Digital Health and Interoperability Working Group. It proposes that tools can be divided into the following high-level categories[56]:

- interventions for clients (e.g. client communication, health tracking, information services, financial transactions);
- interventions for healthcare providers (e.g. client registration, health records, decision support, telemedicine, information management, medication management);
- interventions for resource/ health system managers (e.g. human resources, supply chains, civil registrations, health financing, asset and facility management); and
- interventions for data services (e.g. data collection, coding, mapping, and exchange).

Wazazi Nipendeni assists pregnant women and mothers by providing them with information on how to look after themselves and their infant, so it falls into the broad category of client-facing tools.

This section presents examples of health services falling into sub-categories in the health data collaboration classification:-

Targeted client communication

- Transmit health event alerts to specific population group(s):
  - U-Report Ebola Response in Uganda: 'The following SMS alerts were carefully drafted and sent to Kibaale, and the surrounding districts Hoima, Kiboga, Mubende, Ntoroko, Bundibugyo, Kabarole Kyenjojo, Kyegegwa, Kyankwanzi, and Ibanda. SMS Alert 1: There is an Ebola outbreak in Kibaale. Today and tomorrow I am going to send u some SMSs to give u more info about how to recognise Ebola & how to prevent it...'
- Transmit targeted health information to client(s) based on health status or demographics:
  - Alive & Thrive: '...sent weekly text and voice messages to the phone of microcredit group leader to share messages on breastfeeding with microcredit group.'
  - MomConnect: '...sends stage-based, personalized short message service (SMS) texts to each mom in the registry.'
  - EngageTB: 'Clients who are TB Negative will receive messages about behaviour change to help them avoid the spread of TB and or being infected by TB.'
  - Mobile Information For Maternal Health: 'A mobile interactive voice response system that provides pregnant women with information on the stage of her pregnancy and suggestions to keep her and her baby healthy via twice weekly phone calls.'
  - mDiabetes: '...an SMS-based information service for people with diabetes during Ramadan fasting.'
- Transmit targeted alerts and reminders to client(s):
  - EngageTB: 'Once a client has been confirmed as TB positive, the Lab Technicians will register the client back into the application and enable the client to receive reminders about Directly Observed Therapy (DOT).'

[55] www.healthdatacollaborative.org/
[56] https://docs.google.com/spreadsheets/d/1GEdfI8AQ_wC_SKAm9DhFlNMEnLKlKIcVC46lEws-UIs/edit#gid=2135971936

  - mTIKA: '...send SMS reminders to families when their children are due for immunization services.'
  - Moby App: '... sends automated SMS reminders to clients, reminding them of upcoming appointments, missed appointments, and approaching delivery dates so women can prepare to deliver in a health facility.'
  - Wired Mothers: 'Women receive appointment reminders, educational messaging and can call their primary care providers to discuss non-acute issues.'
- Transmit diagnostics result, or availability of result, to client(s):
  - txtAlert: 'This version of txtAlert delivers CD4 count results to patients who have been tested for HIV but may not return to the clinic to collect their CD4 counts results...'

Untargeted client communication

- Transmit untargeted health information to an undefined population:
  - WAHA Maternal Health mHealth Programme: 'Two SMS campaigns were launched, targeting the inhabitants of the Tambacounda district... The second campaign targets all people, so that they are regularly informed of available medical services within the district.'
- Transmit untargeted health event alerts to undefined group:
  - Ebola awareness through SMS: 'As part of a massive public awareness effort, Senegal's Ministry of Health sent 4 million SMS messages to the general public warning of the dangers of Ebola and how to prevent it.'

Client to client communication

- Peer group for clients:
  - Project Khuluma: 'Peer-led support groups for HIV-infected adolescents to communicate amongst themselves on topics they want to discuss.'

Personal health tracking

- Access by client to own medical records:
  - Digital Weighing Card: 'This project is therefore seeking to provide a digital copy of every child weighing card, such that, it can be accessed via mobile phone whenever needed and updated by Community health Workers at any point in time.'
- Self-monitoring of health or diagnostic data by client:
  - Wearables and fitness trackers: '...tracks every part of your day—including activity, exercise, food, weight and sleep.'
  - Medopad Patient Monitoring: '...you can monitor vital signs, log symptoms, share information with your care providers and more.'
- Active data capture/documentation by client:
  - CycleTel Humsafar: '...she enters the date of her last period and the service informs her of her fertile days during the cycle. She receives alerts on her "unsafe days" throughout the month.'

Citizen-based reporting

- Reporting of health system feedback by clients:
  - U-Report: 'Youth can send alerts to key stakeholders about the issues being faced in their communities, and feeds back useful information to the U-Reporters.'

  - MomConnect: ‘Allow women to engage with the health system through help desk tools and feedback services.’
- Reporting of public health events by clients:
  - EbolaTxT: ‘Citizens can report suspected Ebola cases via SMS.’

On-demand information services provided to clients

- Client look-up of health information:
  - Hesperian Health Wiki: ‘An online source of clear, actionable, and thorough health information accessible via computer or mobile device.’
  - EngageTB: ‘The software enables clients do TB self-screening and access the basic health information related to TB via short messages (SMS) through their phones by sending a code word “TB” to a network neutral toll free short code, and a list of health facilities that have the capability to conduct laboratory tests to confirm TB.’
  - m4RH: ‘a set of text messages on family planning methods that users in can access via their mobile phones.’

Client financial transactions

- Transmit or manage out-of-pocket payments by clients:
  - mHealth for Safer Deliveries: ‘...use mobile banking instead of cash to pay for transportation to the health facility when the woman is in labor or in case of complications.’
  - Changamka Maternal Health SmartCard: ‘The maternal health smartcard is a pre-paid card that allows the bearer to obtain antenatal, delivery, and postnatal services at listed prices in participating maternity facilities.’
- Transmit vouchers to clients for health services, or manage vouchers:
  - Mobile Finance to Reimburse Sexual and Reproductive Vouchers: ‘Voucher program's transmits SMS money transfer to reimburse social franchise service providers for FP services to clients.’
  - Airtel Insurance with MicroEnsure: ‘Airtel rewards loyal customers (who registered for the product by dialling a shortcode) with free insurance as long as they spent a minimum amount of airtime...through monthly SMS communication.’
  - Tanzania National eVoucher Scheme: ‘Web platform that allows clinic workers to issue vouchers for long-lasting insecticide-treated nets, redeemed at nearby retailers.’
- Transmit incentives to clients in relation to health services, or manage incentives:
  - Interactive alerts/Zindagi Mehfooz: ‘A vaccine registry system that uses SMS reminders to caregivers and conditional cash transfers to caregivers ... The amount of cash the caregiver is eligible to win increases with each subsequent vaccine their child completes.’

The classification makes a clear distinction between services providing unidirectional information dissemination to clients (targeted and untargeted) and client-initiated services (peer group, citizen reporting, and health information-seeking). Wazazi Nipendeni is an example of the first of these and is a ‘push’ service. The Viamo 3-2-1 service offered by Vodacom, on the other hand, is an example of a client-initiated service and is a ‘pull’ service, as it relies on the user to dial a short code to access information. In principle, a service could combine both aspects of communication as each has its advantages and drawbacks.

It is interesting to note that most of these examples are based on the SMS functionality of mobile phones. This is true even of the tools that deal with financial transactions, as they tend to use a platform that manages payments between healthcare providers, but the interaction with the client is done by SMS. This reliance on SMS tells us two things. Firstly, SMS is a good enough means of communicating with clients (i.e. constraints such as poor network coverage and illiteracy have not rendered the services unfeasible). Secondly, SMS is regarded as the most cost-effective medium for communicating with clients. This is closely linked to the first point, as voice-based services (such as outbound dialling and call centres) can overcome literacy and language constraints, but come at a much higher cost.

The classification was drafted in 2017, so more recent examples of mobile health projects exist. Many of these are beginning to exploit the potential of the internet, and smartphones in particular, of data acquisition and analysis, and of mobile money services. Some examples are summarised below:

- **Babyl (Rwanda)** is a diagnostic service that uses artificial intelligence and machine learning with live doctors and nurses to provide medical consultations to anyone with a mobile device. It has over 2,000,000 registered users and has performed over 650,000 consultations. Users pay by mobile money. They phone the service and book an appointment with a triage nurse. The nurse then tells them if their condition is treatable digitally. If it is, they get a follow-up appointment with a GP or senior nurse. Clinicians can arrange lab tests, issue prescriptions, and make referrals to health facilities.
- **OMOMi (Nigeria)** is an app that provides pregnant women and mothers with maternal and child health information while connecting them to medical personnel. Its reach is around 40,000 users. OMOMi (meaning ‘My Child’) is free to install and generates revenue through a premium service on the app called OMOMi Chat-A-Doc. This enables users to pay for 24/7 access to online chats with doctors. Payment options include a weekly subscription of 600 Nigerian Naira (£1.30) or a monthly subscription of 1,200 Naira (£2.60). OMOMi is also developing an online marketplace where mothers can purchase baby or mother care products from retailers.
- **M-TIBA (Kenya)** is a mobile service that enables users to send, save, and spend funds specifically for medical treatment. Users can make contributions on behalf of family, friends, or staff, so they can get treatment if needed. Money stored in M-TIBA can only be used to pay for treatment and medication at partner clinics and hospitals. Payments are facilitated through M-Pesa, and funds are managed by UAP Insurance. M-Tiba was set up by a partnership of a health foundation, a mobile operator (Safaricom), and a health finance platform provider. The service currently has 4.6 million users and has paid out 844 million Kenyan shillings (£6.5 million) on 472,000 clinic visits.
- **Docta Ghana (Ghana)** is an app that connects people with doctors in Accra. Users can request a consultation by entering their health concern, and selecting a doctor and preferred time. Users can talk to a doctor or use a video call. The system can also issue prescriptions. The consultation fee is high at around 100 Ghanaian cedi (£15) and can be paid using mobile money, or credit, debit or ATM cards.